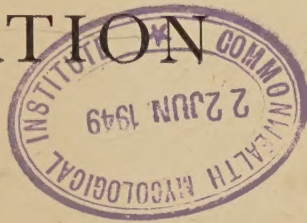


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PROGRESS REPORTS FROM
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SEASON 1947 - 1948

PROGRAMMES OF EXPERIMENTS
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1949

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[Included by courtesy of the Queensland Government.]

QUEENSLAND.

REGIONAL EXPERIMENTAL STATION, BILOELA. PROGRESS REPORT FOR THE SEASON 1947-48.

BY

W. G. WELLS.

INTRODUCTION.

The progress report on the cotton investigations conducted at this Experimental Station during the 1947-48 season has been prepared from the reports submitted by the same officers as those who were responsible for carrying out the work in the previous season.

This past season brought out clearly that, under the irregular climatic conditions of Central Queensland, there should be an ample supply of subsoil moisture at the time of planting the cotton crop. A period of dry weather prevailed from February, 1947, until mid-August, when two rain groups yielded a total of two inches of soaking rain which was followed by good rain in September, fair rain in October, and 10 wet days in November which yielded above normal rainfall for the month. Many of the experiments had an excellent start in October, but plant growth was too rapid under the showery conditions of November and the first half of December. The hot dry conditions which followed at first steadied and then checked the rank plant growth that had developed in all experiments—even on new cultivations. No rain fell from the 15th December until the 28th February, except four light storms of no value. Had three or four feet of wet subsoil been available to supply the plants' moisture requirements sufficiently to prevent the severe square shedding that did occur, a good crop might have been produced following the total of 8.29 inches that fell at the end of February. Further good rains occurred during March and April but plant growth in the rain-grown experiments had been so severely checked that little benefit was received from the late rains. Consequently very poor yields were produced in most of the rain-grown experiments. Such conditions were favourable, however, for growing cotton with supplementary irrigation and very good yields were obtained in most experiments in the irrigation area.

Table I presents the more pertinent data for the season.

TABLE I.

<i>Crop.</i>	<i>Planting Dates.</i>	<i>Picking Dates.</i>	<i>Legal Close Season.</i>	<i>Rainfall</i> 30/6/47—30/6/48	<i>Mean Temperature</i> Oct. to Nov. <i>inclusive.</i>	<i>Mean Yield Lint per Acre.</i>
Rain-grown cotton	8—24 Oct. 4—11 Nov.	15th March until end of August.	Nil	34.15 ins.	Max. 85.6°F. Min. 58.6°F.	46 lb. 114 lb. <i>Total 37.7 acres.</i>
Irrigated cotton ...	8—24 Oct.		Nil	+ 3 to 4 applica- tions of 3 inches per acre.	Max. 85.6°F. Min. 58.6°F.	570 lb. <i>Total 8.6 acres.</i>

METEOROLOGY.

The total rainfall for the 12 months ending 30th June, 1948, amounted to 34·15 inches compared with the mean of 27·92 inches for 1924-48. The excess over the mean for the life of the experiment station was largely the result of three groups of very heavy rain that were interspersed with very dry conditions. Consequently, although the quarterly rainfall distribution showed no marked deviation from the previous quarterly means, the irregular distribution within each quarter brought about stress conditions for plant growth especially during December and January. Although there were only 59 days on which rain was experienced compared with a mean of 74 days for previous years, the percentages of the three classes used to classify the station rainfall were about normal, with 13·22 inches or 38·7 per cent. of the season's total being in the heaviest class, i.e., falling at a rate exceeding 0·70 inches per hour—the actual mean for this class being 1·55 inches per hour.

Maximum screen temperatures tended to be below normal except during a rather hot February when 102° F., the absolute maximum of the season, was experienced. The minimum screen temperatures were appreciably above normal during the wet spring but tended to be below normal for the rest of the season.

AGRICULTURAL PRACTICES.

The yields obtained in the rain-grown experiments were so severely affected by the long dry period experienced at mid-season, that the results are mostly of little value. About the only clear cut result was that once more, irrespective of the time of ploughing, cotton following cotton or grain sorghum, on land in the third or more years of cultivation after grassland of any type, was outyielded by cotton following Rhodes grass.

Mechanical Harvesting.—The trials of mechanical harvesting of cotton that have been conducted in the past at the experiment station and on commercial farms in the adjacent districts, have shown that, provided highly suitable conditions were available for the machine used, very satisfactory results could be obtained. It was apparent, however, that a more robust type of machine was required for harvesting general commercial crops and accordingly one of the newer machines manufactured by the International Harvester Company, U.S.A., was purchased conjointly by the Commonwealth and Queensland Governments and the Cotton Marketing Board of this State. Cotton crops in which to test the machine were arranged both on farms in the district and on the experiment station. Unfortunately unavoidable delays in its arrival in Australia prevented the trials from being conducted until the end of June. Consequently only cotton left unpicked on the experiment station was available for testing the machine at this late date. Although the cotton had started opening by the end of March and had experienced 4 inches of soaking rain a week before the trial was

conducted, the machine harvested 85 per cent. of the crop that was still on the plants, much of it hanging well out of the boll. The mechanically harvested and the companionate hand picked cottons were of equal grade, and a noticeable feature of mechanically harvested 1.1/16 inch cotton was that there was less tendency towards the ropiness or twisting of the locks of seed cotton and the resultant lint cotton that had been noticeable in cotton harvested by the machine used previously—the larger diametered spindles of the I. H. C. machine apparently being an improvement in this respect.

In order to obtain more favourable conditions for testing the new machine this season, it was transferred to another experiment station in North Queensland where lack of frosts allows of planting cotton at the end of the wet season for growth under irrigation conditions until the start of the following wet season. A trial was conducted in a commercial crop in this district, and where a suitable type of plant of open habit of growth had been obtained by careful regulation of plant spacing and application of the time-table of irrigation, the machine harvested approximately 100 per cent. of the 750 lb. crop of cotton that was open on the first picking. Where a more bushy type of plant was present approximately 85 per cent. of the crop was harvested. The results obtained as a whole with the machine were most encouraging and further more extensive testing of it is planned.

IRRIGATION INVESTIGATIONS.

The investigations in cotton irrigation consisted of a repetition of the time and rate of spray irrigation experiment conducted in the previous season, a combined varietal and rotation experiment, a trial of strains evolved in the breeding programme for jassid resistant cottons, a varietal trial of quick maturing varieties, and a pest control experiment. The seasonal conditions were very favourable for growing cotton with supplementary irrigation and good yields as a whole were obtained.

Time and Rate of Spray Irrigation Experiment.—This experiment was a repetition of the one reported upon in the 1945-46 Progress Report. Owing to the fact that a total of 5.78 inches of rain was received during August and September, it was decided to eliminate the usual planting irrigation if a suitable rain occurred by mid-October. Accordingly the experiment was planted on the 7th October following a rain yielding 1.26 inches. The results indicated that the treatments which provided sufficient subsoil moisture to enable the crop to develop satisfactorily through January out-yielded all other treatments, including those which received the same or nearly the same amount of water for the season but in applications at mid-season rather than in the early season. The leading treatment yielded 637 lb. lint per acre and received 13.3 inches of spray irrigation per acre in 4 applications, one of which consisted of 3 inches of water applied a fortnight before the whole experiment was planted. Another treatment, receiving the

same total amount of irrigation, but in an application of 6.6 inches on the 3rd January and the same amount again on the 3rd February, yielded 95 lb. of lint less per acre. Similarly treatments receiving the same total amount of irrigation water but distributed on time-tables which embraced 3 inch applications when the plants averaged either 6 inches or approximately 18 inches in height, did not yield as well as the leading treatment but did produce better than the treatments which did not receive their first irrigation until early in January. The results obtained over the duration of the experiment all tend to indicate that it is advisable to provide sufficient subsoil moisture prior to planting to enable the plants to develop satisfactorily until the start of the main flowering period without the assistance of an additional irrigation applied during even the early stages of plant growth.

Combined Varietal and Rotation Experiments.—The results obtained in the preliminary experiment of this type conducted in the 1946-47 season indicated that crop rotations influence the yields of cotton produced with supplementary irrigation. As the results of many experiments conducted at this centre in rain-grown cotton have also indicated that rotations affect cotton yields, a more comprehensive long term experiment was started this season. Briefly, the treatments consist of growing Rhodes grass for three years with and without supplementary irrigation, followed by irrigated and non-irrigated cotton, and an alternate rotation of cotton and grain sorghum grown with and without supplementary irrigation. In the interval until the full comparison of treatments can be obtained following the ploughing out of the Rhodes grass, varietal trials of cotton and grain sorghum will be grown in the companionate areas to show the value of the supplementary irrigation.

This season's experiment embraced a comparison of the standard Miller 41S and two of the jassid resistant hybrids bred at the experiment station, grown with and without supplementary irrigation following irrigated and non-irrigated sorghum of the previous season, and with supplementary irrigation following irrigated cotton. The results indicated that, on this eight year old cultivation from the virgin grassland condition, irrigated cotton following irrigated sorghum tended to outyield irrigated cotton following irrigated cotton, and highly outyielded non-irrigated cotton following non-irrigated sorghum. The year was, of course, very dry.

There were no significant differences between the yields of the three strains, although both hybrids tended slightly to out-yield the standard variety under non-irrigated conditions.

SOIL MOISTURE AND NITRIFICATION STUDIES.

Studies relating to the moisture and nitrate content of the various ages and types of cultivations used in the conduct of the programme of experiments again played a prominent part in the season's operations.

The previous autumn and winter were exceptionally dry. Consequently, in all areas that had been under crop, the moisture content of the top three feet of soil approached wilting point at ploughing time. Although a total of 6.88 inches of soaking rains was experienced during the seven weeks preceding the planting operations commencing on the 7th October, the average depth of wet soil at that date averaged approximately only 25 inches. A further rain group of $2\frac{1}{2}$ inches early in November increased the wet zone to 30-33 inches, which was the maximum depth of moist soil for the season in most rain grown experiments. The favourable development of the crop thus depended on regular and timely replacement of the soil moisture as the plants utilized it. The showery conditions of November stimulated rank growth of a vegetative type in the early October plantings, and their resultant high rate of transpiration during the hot dry conditions of late December rapidly depleted the moisture supply by the end of that month. Where planting had been delayed until mid-November, however, the smaller and less luxuriant type of plants did not utilize moisture so rapidly, and consequently November plantings, especially those following early ploughed grassland, withstood the long dry summer better and produced on the average higher yields than October plantings on comparable areas.

There were no substantial differences in the depth of penetration in old cultivations repeatedly cropped to cotton and in land in cotton in the first or second year after three years of Rhodes grass. Moisture was generally found to a greater depth, however, in adjacent cotton on land in the first year of cultivation out of virgin grassland. Very substantial differences were also obtained between the depth of penetration in row cropped land and adjacent areas in Rhodes grass—the difference amounting to as much as 10 inches of wet soil in favour of the areas in grass in some instances.

Nitrate determinations indicated once more that, following a very dry autumn and winter, the occurrence of good late spring and early summer rains results in early and rapid nitrification taking place in the old cultivations. Consequently, the nitrate readings were generally higher than usual during October and November, and, in conjunction with the showery conditions during November, promoted a very sappy vegetative type of plant in most of the October plantings. The peak of nitrate production was apparently reached early in December, and, under the following dry conditions, utilization of nitrates overtook production to such an extent that plant response to the late February rains was very retarded. Nil readings were recorded in all soil sampling of the Rhodes grass areas, and it was very apparent that in many areas of this grass there was an insufficiency of nitrates from mid-season onwards.

COTTON VARIETIES.

A comprehensive range of experiments embracing trials of commercial varieties, comparison of commercial varieties and the more advanced strains of the jassid breeding programme and comparisons of

the various newer strains evolved in this programme, was planted this season under a wide range of conditions. The extremely irregular distribution of the rainfall affected most of the rain-grown experiments so severely, however, as to make their yields of somewhat doubtful value. Very satisfactory results were produced in most of the experiments grown with supplementary irrigation and hence considerable progress was achieved in assessing the relative productivity of many of the newer more promising strains. Unfortunately, the lack of a severe jassid attack prevented the final answer from being obtained on the relative merits of these strains under conditions of severe jassid infestation.

The more important results of the season's work are summarized as follows :—

Cotton Breeding.—Work was continued in (a) the further purification and continued backcrossing in the hybrids between Lone Star, New Mexico Acala, Triumph and jassid resistant parents, (b) progeny increases of jassid resistant Miller strains, (c) progeny increases of Miller backcrosses, (d) increases of certain resistant Miller strains and (e) the testing of numerous new hybrids and Miller strains, including the strains of the non jassid resistant Miller 43-9 which are characterized by much higher lint percentages than ordinary Miller types.

Jassid Resistant Miller.—A trial to compare the jassid resistant Miller strains which were destroyed by an invasion of *Loxostege affinitalis* last season was planted with residue seed on a commercial farm near the experiment station. Although adverse growing conditions affected the trial, the fact that it was planted on new cultivation allowed of the production of considerable crop and the most promising strains were picked in bulk to provide seed for strain trials on the experiment station in the coming season. Some of the strains had larger bolls and longer fibre than the main jassid resistant commercial cotton Lot 1.

Jassid Resistant Hybrids.—A block of progeny increases of 4th and 2nd Miller $\times$ U.4 backcrosses was grown in isolation from other cotton, with small plots of grain sorghum to separate the strains. Although the area was in the sixth year of row cultivation, an average yield of 750 lb. seed cotton per acre was obtained, with one strain producing at the rate of 960 lb. per acre—all under rain-grown conditions. The leading strain is the result of seven years of selection out of a 2nd backcross and appears to be more uniform in most of the measured characters than the commercial varieties of the district. It is highly jassid resistant and has large bolls, fibre of good quality and a high ginning percentage, and has yielded well when grown with and without supplementary irrigation. It will, therefore, be well tested against jassid resistant Miller strains in the coming season preparatory to increasing seed supplies of it for trials in commercial plantings.

Strain Trials.—As mentioned in previous Progress Reports, irrigation trials of hybrids evolved in the programme developed to supply jassid resistant cottons have always been planted late to promote luxuriant growth and thus provide optimum conditions for jassid infestation. Sufficient trials of this type have been conducted to demonstrate that a considerable number of strains with satisfactory jassid resistance are now available. Accordingly, a 13×4 Randomized Block trial of the leading strains and two commercial Millers was planted early this season and grown with supplementary irrigation. Four irrigations totalling 11.8 inches per acre were applied to the trial, the mean yield of which was at the rate of 2,093 lb. seed cotton per acre, with the 5 highest yielding jassid resistant strains producing at the rate of 2,240 lb. seed cotton per acre and the two commercial Millers only 1,650 lb. seed cotton per acre. Jassids were almost completely absent from this trial.

In rain-grown trials of jassid resistant strains and commercial cottons, yields were mainly low, but in each experiment the jassid resistant strains, as a whole, produced the highest yields. Considerable variation in the relative positions of the same strains in different rain-grown trials indicated that, in a season experiencing such irregular rainfall and long periods of stress conditions, it is highly advisable to have several carefully designed trials of the same comparison of strains and varieties to allow accurate conclusions to be drawn.

The advent of satisfactory types of mechanical cotton pickers with requirements for a specialized type of plant growth, and the difficulty of producing this growth on irrigated fertile soils in this State, make it necessary to examine the merits of varieties suitable for these soils. Accordingly, in addition to testing the regular commercial cottons of the district and the strains being evolved at the experiment station, a 5×4 Randomized Block trial of the most promising of the varieties with an open habit of growth, which are being used on fertile alluvial soils in the southern districts, was also grown at Biloela with supplementary irrigation. Although these varieties suffer in comparison with the Miller strains as regards boll size and drought resistance, the open habit of growth of the leading strain of the trial makes it appear to have promise of being suitable for growing under conditions of supplementary irrigation and mechanical harvesting—its yield per acre being at the rate of 661 lb. lint cotton of good quality.

ENTOMOLOGY.

Experimental work on the control of *Heliothis* was continued in the 1947-48 season, principally on irrigated cotton. Unfortunately, although insect activity was quite noticeable and had its effect on the crop, on this occasion variability among the plots of a 6×4 randomized layout was such that statistically significant results were not obtained.

Treatments that were used in the experiments included 90 per cent. lead arsenate dust as a standard treatment and various timing schedules of 0.4 per cent. D.D.T. spray.

In this season also, observations on populations of the cotton aphid, *Aphis gossypii*, on variously treated cotton were continued. Assessments confirmed the fact that applications of a combined dust of 90 per cent. lead arsenate, plus 0.3 per cent. nicotine caused an acute increase in the aphid population. Applications of 0.4 per cent. D.D.T. sprays in various schedules also appear to be associated with a sudden multiplication of aphids. Hence, it was shown that should the use of D.D.T. sprays become warranted for the control of *Heliothis* and other cotton pests, it would seem desirable to incorporate a suitable aphicide. Likewise, observations on red mite populations in plots specially sprayed for the purpose indicated that, following D.D.T. treatment, infestation increased acutely in rain-grown cotton on a poor soil type, and less so in irrigated cotton under better conditions. Thus an acaricide may also be required with D.D.T. Although a thorough application of sulphur dust proved quite effective in controlling the mites, the addition of hexaethyl tetraphosphate, which is both an aphicide and an acaricide, may solve both of the problems of aphid and mite control on D.D.T. treated cotton.

PROGRAMME FOR 1948-49.

The proposed programme for 1948-49 embraces the following investigations.

Plant Breeding.—Owing to the transfer of Mr. Marriott to another field of activity as a consequence of the occurrence of a vacancy following on the reorganization of a branch of the Department, it will be necessary to confine the work in the programme of development of jassid resistant cottons to the extensive testing of the goodly number of strains which he has evolved. A comprehensive series of strain trials grown with and without supplementary irrigation, and the multiplication of the most promising strains of this past season will, therefore, comprise all of the breeding work that can be carried out in the coming season.

Agronomic and Varietal Experiments.—A continuation of the general programme attempted in the 1947-48 season and amplifications of the same in certain directions.

New work will include :—

- (a) The continuance of the time and rate of spray irrigation experiment on second year cultivation to test the applicability to the newer cultivations of the findings of recent years on ageing cultivations.

- (b) Mechanical harvesting of the leading high yielding variety of open habit of growth tested in the 1947-48 season.
- (c) Mechanical harvesting of the leading commercial varieties of the district.
- (d) Testing of the merits of flame cultivation.

Entomology.—Insecticide experiment on irrigated cotton to test the merits of the main D.D.T. treatment which is tentatively recommended to cotton growers at the present time. —

SOUTH AFRICA.

COTTON EXPERIMENT STATION, BARBERTON. PROGRESS REPORT FOR THE SEASON 1947-48.

INTRODUCTORY NOTE

BY

D. MacDONALD.

The season 1947-48, despite a certain amount of damage to the cotton crop by hail and insect pests, can be classified as good in view of the high final yields of lint per acre obtained.

A summary of the season's conditions is given in Table I.

TABLE I.

<i>Planting Dates.</i>	<i>Picking Dates.</i>	<i>Legal Close Season.</i>	<i>Rainfall.</i>	<i>Mean Temperatures.</i>
21st-27th October 12th-24th November	May to August	Nil	34.84 inches	1/11/47-30/4/48 Max. 82.1°F. Min. 62.6°F.

The basic breeding programme followed that outlined in previous Reports and consisted mainly of yield testing and selection within hybrid material bred on the Station in past seasons.

By use of the new technique evolved and described in the 1946-47 Report determination of the relative leaf lamina hairiness of all strains included in the season's Variety Tests was carried out. It is satisfactory to be able to record that, with very few exceptions, the hybrid strains were decidedly superior to U.4/5143 and A.2106, the strains at present in general cultivation.

Studies in laboratory methods with cotton were continued, and a rapid method for determining hair weight per unit length is reported on together with the result of investigations into the amount of lint lost from the seed through combing.

Insect pest attack was generally heavier than that of recent years, particularly in the case of bollworm (*Heliothis sp.*) and jassid.

American bollworm was present from early January and developed into a severe attack during February which continued into mid-March. Jassid infestation, one of the heaviest ever recorded, was of inestimable value in exposing all the new hybrid selections to a thorough field test of resistance to this pest. All the most promising strains from the various inter-species and intra-species crosses showed full resistance, except for the progenies of two families derived from the M.U.8 × Tide-water cross, which showed up as not breeding true for the high standard of resistance aimed at in the breeding programme and hence could be discarded with confidence.

Even U.4 strains, which under conditions of normal jassid infestation are fully resistant, showed jassid "effect" when grown alongside completely resistant strains, and "slight damage" when adjacent to susceptible varieties.

Aphis was widespread during late January and early February, but little real damage was done to the crop. Though no detailed counts were made, field observations indicated that the stainer population was similar to that of previous seasons, but damage due to internal boll disease was negligible. A leaf rolling caterpillar caused a slight amount of damage to the later varieties during late March and April. The insect has been bred through to the moth stage but has not yet been identified.¹

During previous seasons *Xanthomonas malvacearum*, though it could be found in the crop in the form of Angular Leaf Spot, was not common and never affected crop production, except in the case of some susceptible progeny plots of hybrid material, which were automatically discarded. In the present season the incidence of *X. malvacearum* was higher than ever previously recorded, not only in the form of Angular Leaf Spot but more commonly in the form of vein, petiole and stem lesions. The disease was not confined to the more recent hybrid strains, but occurred equally freely in varieties like U.4/5143, M.U.8 etc. which are normally resistant. Full details of the incidence of the attack are given by Dr. Wickens in his section of this Report.

Owing to higher prices for both lint and cotton seed relative to those of other crops, the acreage under cotton in the Barberton area and the Low Veld generally showed a considerable increase. Final figures for the season's crop are not yet available, as ginning is not yet completed, but the Barberton Ginnery estimate that their season's output will exceed 2,400 bales of lint compared with a total production of 919 bales for the previous season.

One of the most remunerative crops in this area has always been snuff tobacco; owing to the fact that in the past the demand always exceeded the supply, this commodity commanded a high price. Production of snuff tobacco is now reaching saturation point and this, together with the increase in price for both lint and cotton seed, is having a stimulating effect in increasing the area under cotton.

Sufficient cotton seed to plant upwards of 12,000 acres has already been issued to growers by the Barberton Cotton Co-operative Co., and given reasonable climatic conditions during the coming season it is possible that a record crop may be reaped.

METEOROLOGY.

The total rainfall for the season, 34.84 inches, was considerably above the average for the past twenty years. At no period during the main growing season did the crop suffer from drought, the rainfall distribution being reasonably good throughout, apart from the fact that during November and December over 15 inches of rain fell, which made weed control extremely difficult.

¹ This has now been identified as *Sylepta derogata* F., which has not previously been recorded from South Africa.

Cotton planting was begun in the last week of October, but because of two hailstorms on the 4th and 13th of November, which caused damage and necessitated a certain amount of replanting, it was towards the end of November before cotton planting was completed.

Growth during the season was generally very vigorous mainly on account of ample soil moisture, but partly because of heavy American bollworm attack, with the result that final plant size was well above the average for this Station.

Little effective rain fell after the end of March, but the reserve of sub-soil moisture established during the season was sufficient to enable most of the late set crop to mature, as shown by the fact that A.2106 gave the highest yield of lint per acre ever recorded on this Station by any strain, in spite of heavy damage in mid-season by bollworm.

PLANT BREEDING SECTION.

BY

D. MacDONALD, H. E. KING and J. M. MUNRO.

GENETICS AND BREEDING.

Variety Trials.—Two replicated variety trials were planted, containing in all 37 strains. These included U.4×Sea Island, M.U.8×BP.52 and M.U.8×Tidewater selections, together with BP.52, A.2106 and U.4/5143 as “controls.” At one period early in the season prolonged damp cloudy weather, associated with heavy aphid infestation, resulted in a check to growth, but thereafter growth was good throughout and the final plant size attained by U.4/5143 was much above normal. Yields, in spite of very considerable loss of fruit through bollworm attack (chiefly *Heliothis*), were extremely high, that of A.2106 in one of the two tests constituting an all-time record for Barberton. Frost cut off the extreme tail end of the crop in one test but the other escaped.

Both trials had good stands and were reasonably uniform in growth, giving useful information on the relative merits of these various types under the conditions prevailing. In view, however, of the somewhat abnormal weather it is essential to take the results with a measure of caution and to await the results of a second season's trials before making firm deductions. It is noteworthy that the relative yields of U.4/5143 and A.2106 did not fall in with previous experience. A.2106 outyielded U.4/5143 by only 15% in one test and no more than 4% in the other, as against an average difference in favour of A.2106 of 46% in previous trials. In each of the trials the difference

required for significance at $P=0.05$ was under 7% of the yield of U.4/5143. Observations throughout the season suggested that conditions favoured the early cropping types, while the potentially far heavier yielding but later types such as A.2106 suffered disproportionately from long continual bollworm infestation and a certain amount of damage by *X. malvacearum*. In agreement with this, the comparative results from the various hybrid strains reflected their relative earliness of cropping. The most successful were the M.U.8 $\times$ BP.52 lots, the best of these, A.618, giving a yield of 676 lb. of lint per acre and an increase over U.4/5143 of 10%. This yield was topped only by A.2106, which with a figure of 707 lb. lint per acre in the Main V.T. must still be regarded as beyond doubt the most satisfactory strain in general for the Barberton district. The importance of the results obtained with the new hybrid material lies in the fact that, although not equalling A.2106 in yield per acre, many of the selections proved to be extremely good croppers, *while possessing longer and finer lint*. (Notes on the spinning quality of some of this material are given in a later section.)

Of the U.4 $\times$ Sea Island material, the 16 strains included in the main test averaged 430 lb. of lint per acre, with the best giving 514 lb. and even the worst attaining 363 lb. It is thus clear that this interspecific hybrid material, after seven generations of careful reselection, incorporates a large measure of the yielding powers of the U.4 parent. All these hybrids carried lint of very considerably greater length than U.4. The longest, of which the yield was 480 lb. per acre, gave a length of 39 mm. on the combed seed against 32 mm. for U.4/5143.

An increase of this order would undoubtedly have been quite impossible to obtain by selection within U.4 material itself and a combination of 39 mm. length with a lint yield per acre of 480 lb. (under rainfall) represents an achievement of some interest.

The M.U.8 $\times$ Tidewater hybrids proved later croppers and perhaps in consequence of this were disappointing in total yield, although possessing many attractive features such as large bolls and long silky lint.

Although the hybrid selections included in the trials were intended only to provide preliminary indications of yielding powers and lint quality, several approached a satisfactory degree of general vegetative uniformity. The M.U.8 $\times$ BP.52 backcrosses, which were only at the F_4 generation from the backcrossing, were all good, while at least one of the U.4 $\times$ Sea Island crosses (A.6553) was extremely uniform, with a habit of growth and fruiting approaching the standard set by U.4 itself. Several, including some of the best yielders with good lint length, were not much inferior. It may therefore be taken that further selection within this material, to obtain strains sufficiently uniform in all respects for issue as commercial varieties, will not necessarily result in a loss of the yielding power at present existing.

In resistance to jassid almost every one of the hybrid strains was clearly superior to U.4/5143, indicating that the ruthless elimination of types with poor leaf hairs over a number of generations has proved a completely successful method of ensuring high resistance. U.4/5143 itself is sufficiently hairy to escape real damage but in this season of unusually heavy infestation showed symptoms of attack while the hybrid strains remained free.

TABLE II.

SUMMARY OF THE RESULTS OF MAIN VARIETY TEST 1947/48.

Strain.	Gin. %.	Seed Weight.	Lint Length mm.	Lamina hairs per sq. cm. at .5 mm. Mean of 12th and 16th leaf.	Yield lb. lint per acre.
A.2106	37.6	11.5	33.8	139	707
5143	38.1	8.8	32.2	102	615
BP.52 (Barberton reselected)	34.5	9.2	33.9	160	541
M.U.8 × BP.52 ² —A.616	36.2	9.9	34.6	207	651
—A.618	36.7	9.4	34.9	181	676
M.U.8 × U.4/8161 A.449	36.1	13.2	32.5	163	642
M.U.8 × Tidewater A.5798—99	32.2	12.5	36.5	142	493
M.U.8 × Tidewater A.5805—06	31.6	11.8	34.9	190	443
5 highest yielding Sea Island × U.4/8161 :—					
Strain A.6476	33.6	11.6	39.0	186	480
A.6478	33.8	13.2	35.9	205	514
A.6479	33.6	12.5	34.3	211	468
A.6644	36.1	10.1	35.0	140	458
A.6620	36.8	11.0	36.6	149	453
Mean of 16 Sea Island × U.4/8161 strains ...	34.4	11.4	36.7	184	430

Diff. required for significance $P=.05$ 40 lb. lint per acre.

Notes were made during the picking of these variety tests on the relative "pickability" of the strains and on the appearance of the seed-cotton. Many of the U.4 × Sea Island strains were inferior to straight *G. hirsutum* material, but there were indications of strain differences within the crosses in these respects, giving promise of response to selection for better boll opening and fluffing out of the cotton. With progressively increasing difficulty in obtaining sufficient labour for picking it is important that a new strain should not prove any less easy to pick than its predecessor.

Progeny Line Reselection Work.—Over one thousand progenies of single plant selections of the previous season were planted, covering an area of more than 30 acres. As a result of hail damage to the first planting a second planting of material of which further seed was available added a further 8 acres. The hail-damaged seedlings later recovered so well that in effect this gave two replications of many of the progenies, enabling greater confidence to be placed in the judgment of the material, but adding to the volume of the field work. The majority of the progenies were closely related to the strains in the variety tests and it was therefore possible before the end of the season to concentrate on those lines promising well in the tests and to reduce work on the less promising.

Growth was strong and yields on the whole high, but bollworm took a heavy toll and its uneven incidence added to the difficulties of selection work.

Selections totalling 1,650 single plants and some 115 bulks, representing M.U.8 × BP.52, U.4 × Sea Island and M.U.8 × Tidewater, were brought in and put through routine laboratory tests.

The field notes and laboratory records indicated that, in the case of the M.U.8 × BP.52 material, a great number of progenies were of very satisfactory uniformity and possessed a good combination of fruitfulness, ginning percentage and lint length. Amongst the U.4 × Sea Islands there was less consistent uniformity but many highly satisfactory progenies were available, including some showing extreme lint length and others with a good combination of lint length and ginning percentage.

Ample single plant selections have been chosen from these two crosses, and lint from many of the better progenies has been dispatched for small scale spinning tests, seed at the same time being prepared for inclusion in variety tests and small multiplication plots.

Six acres of single plant selections of the M.U.8 × Tidewater cross were planted, all the selections being derived from three single plants originally selected in F₂. The extremely heavy jassid infestation experienced during the season enabled striking differences to be noted in the relative degree of resistance shown by the progenies of the three families. The progeny plots of one of the families showed a markedly higher degree of jassid resistance than those of the other two, while at the same time they combined this character with good fruiting and uniformity of plant habit equal to and in many plots better than the progenies of the susceptible families.

Field examination of open bolls having shown that the lint of the jassid resistant family was equal to that of the other two more susceptible groups, single plant selection work was confined to the resistant family.

Laboratory analysis of the single plant selections made in this family is not yet complete, but lint of nine bulks will be submitted for spinning test.

In addition to the above single plant selection work, 150 small bulks of other breeding material, derived from U.4 × Cambodia crosses, M.U.8 × U.4/8161, BP.52 × Sea Island and M.U.8 × Sea Island were collected for laboratory work and storage of seed for future use at the new Cotton Research Station in Uganda.

Results of Spinning Tests of Lint Samples of the Previous Season.—As recorded in the 1946–47 report, 20 samples from that season's crop were submitted to the Shirley Institute for spinning test and hair character determinations. The results obtained were of very considerable interest. BP.52 (ex Uganda but Barberton grown, and

representing a reselection for greater plant hairiness) included as a "control" gave a "highest standard count" of 62, a figure not far short of those obtained for Uganda grown samples of the original strain in some seasons. Two samples, representing the M.U.8 $\times$ Tidewater hybrid material, gave H.S.C's of 62 and 64, while two M.U.8 $\times$ BP.52 selections, A.616 and A.618, gave figures of 63 and 54. All these figures are well above the general run of previous samples from Barberton. The average H.S.C. for U.4/5143* for 11 samples submitted between 1938-39 and 1945-46 was 29, while that of A.2106 from 3 samples forwarded between season 1943-44 and 1945-46 was 31.

The remaining 15 out of the 20 samples sent were of U.4 $\times$ Sea Island origin. The average H.S.C. for these 15 was only 45 which, although very definitely better than the figure mentioned above for U.4/5143, is nevertheless most disappointing. Even the best one, with an H.S.C. of 57, fell a little short of BP.52, while two gave values of 35, and one was 30.

These disappointing values, for hybrid strains having Sea Island as one parent, are still more difficult to understand when the measured hair characters are considered. Thus the longest of the U.4 $\times$ Sea Island hybrids was given an "Effective Length" of 45 (32nds inch) against 40 for BP.52, and the finest had a standard hair weight of 148 against 163 for BP.52.

Thus there appears to be no relationship between spinning quality and the measured hair characters, length and fineness. A partial explanation of the disappointing spinning performance of these hybrids may lie in the high percentage of short fibres. These ranged from 28% to 43% with an average of 34%, and it has been found (King 1948) that the calculation of partial correlation coefficients brings out a relationship between yarn strengths and these characters.

Some attempt has been made at Barberton to work out a method of determining approximately the percentage of short hairs by weight on the combed seeds, but lack of staff and suitable apparatus has prevented adequate trials. The data which it has been possible to collect suggest very strongly that genetic differences do exist within the hybrid material. It is thus possible that an improvement in this character could be achieved relatively easily.

An excessive proportion of short hairs does not, however, seem sufficient to explain the disappointing results with this material and further investigation is clearly desirable. Samples of the majority of these strains, taken from the 1947-48 variety tests, have been sent for further testing and a considerable number of new bulkings of the same origin are being submitted for small scale tests.

* 5143 was the standard U.4 strain in cultivation in Barberton district, and has now been replaced by A.2106. Some other U.4 selections have been better spinners but less satisfactory in field characters.

TABLE III.
MAIN SPINNING TEST RESULTS ON SAMPLES FROM THE 1946-47 CROP.

Strain.	Effective Length 32nds inch	% short fibre.	N-D	Standard Hair Wt.	Count $\times$ Strength product.	H.S.C.
BP.52	40	29	50-19	163	2478	62
A.5798-99	42	29	53-14	173	2338	62
A.5805-06	43	30	43-19	167	2370	64
A.616	38	27	47-22	167	2296	63
A.618	39	27	49-24	184	2260	54
A.6436	39	33	43-24	172	2157	48
A.6443	43	30	43-21	190	2039	43
A.6450	42	32	44-16	177	1837	30
A.6454	42	35	43-19	156	2024	42
A.6457	40	43	44-21	148	1870	35
A.6469	41	38	39-27	153	2190	49
A.6476	44	34	43-23	158	2212	51
A.6478	40	28	47-22	188	2145	50
A.6479	40	29	50-21	172	1901	35
A.6502	45	34	40-26	175	2057	45
A.6510	42	34	40-26	162	2153	53
A.6553	44	33	35-29	182	2181	53
A.6620	41	33	45-24	195	2027	41
A.6644	39	36	43-19	171	2145	46
A.6648	40	35	34-26	184	2308	57
MEAN OF 3 SEASONS SPINNING TEST RESULTS.						
5143	38	31	43-20	225	1654	28
A.2106	38	30	53-13	216	1804	31

PLANT HAIRINESS.

No new experimental work was carried out, but the modified method of recording leaf hairiness, described in last season's report, was given a thorough large scale test. For this purpose all the thirty-seven strains in the two variety tests were sampled, leaf strips being taken from five plants per plot and six plots per strain on two occasions during the growing season. On the first occasions the 12th main stem leaf was sampled and on the second the 16th. This involved the examination in all of 2,220 leaf strips, each representing 25 sq. mm. of lamina surface. The whole task of sampling and recording, which involved placing some 300,000 hairs into three length classes, was accomplished without difficulty and, apart from the sampling, was largely completed by one worker within a period of less than three weeks.

The results indicated that almost without exception the recently bred hybrid strains were significantly superior in leaf hairiness to U.4/5143, and the great majority were in fact better than A.2106. Taking the mean number of hairs per sq. cm. at a height of .5 mm. on the two leaves, the difference between strain means required for significance at $P=0.05$ was 16% in one trial and 17% in the other. The range within one trial of 25 strains was from 249 hairs per sq. cm. for one of the U.4 $\times$ Sea Island hybrids to 102 hairs per sq. cm. for U.4/5143. The high figure for U.4 reflects the good growing conditions.

JASSID INFESTATION.

The usual routine counts were made on a series of standard strains, and records were also made on some new introductions of wilt resistant Acala and Stoneville. In all cases the infestation was in keeping with the lamina hairiness.

In an attempt to ensure a satisfactory crop of seed from some multiplication plots of jassid susceptible strains, repeated sprayings with DDT 0.1% water emulsion were carried out on small areas. Counts of nymphs on these indicated that spraying gave adequate protection only for a period of three or four weeks, after which reinfestation took place and very rapidly reached high levels. The sprayed areas were adjacent to unsprayed susceptible cotton.

The general level of jassid infestation on the experimental farm was unusually high, counts of up to 13 nymphs per leaf being recorded on fully susceptible types. U.4/5143 showed some infestation both on the farm and in the district, but was only damaged in any degree when adjacent to heavily infested susceptible cotton in the experimental plots. In seasons such as this, however, the increased safety margin obtained by growing A.2106 is specially worthy of consideration by commercial growers.

WILD COTTONS.

Seed of six wild species of cotton supplied from the Sudan collection was planted to investigate their reactions to Barberton conditions.

G. somalense failed altogether to germinate.

G. armourianum appears to be physiologically unsuited to this environment, growing very slowly, and producing no flowers. The leaves are completely hairless, and jassid nymphs were observed on them, though there was very little visible jassid damage. Leaf spot and blackarm were rather severe.

G. raimondii grew vigorously, and flowered freely rather late in the season, but set no fruit until November when it was possible to find an odd boll set. Whether these few bolls will shed or develop to maturity remains to be seen. The leaves carry a dense mass of very short hairs, jassid infestation was slight—up to 68 per 100 leaves—and discoloration of the leaf margins was general. Mild leaf spot occurred on the older leaves, but no blackarm damage.

G. stocksii grew well, but the larger branches tended to die back later in the season. It also flowered freely, but set no fruit. The leaves are hairless, but jassid infestation was slight and caused no visible damage. Leaf spot was rather severe, and a moderate amount of blackarm damage occurred.

The leaf hairs of *G. anomalum* were studied in detail, as this species has been regarded as a potential parent for breeding hairy-leaved cottons. At Barberton, leaf hair counts have been standardised on the 16th main stem leaf, and a count of 150 hairs per sq. cm., exceeding .5 mm. in height, is adequate for complete jassid resistance. *G. anomalum* had an average count of 11. It was observed, however, that jassid counts were practically nil, and further work showed that the number of hairs increases progressively on later leaves, and the 36th main stem leaf averaged 433 hairs per sq. cm. exceeding .5 mm. in height.

It is not necessary, all the same, to resort to the wild species, to introduce a high level of leaf hairiness, as an equally effective and earlier developing covering of hairs has been found among cultivated cottons. Within *G. hirsutum*, the 16th main stem leaf of M.U.8 has 320 hairs per sq. cm. exceeding .5 mm., and 32 exceeding 1 mm.; similarly, within *G. barbadense*, Tanguis produces 500 hairs per sq. cm. exceeding .5 mm., while the best U.4 $\times$ Sea Island hybrid gives counts of 500 at .5 mm. and 65 at 1 mm.

G. anomalum and *G. davidsonii* both grew well and fruited freely. Leaf spot and blackarm were negligible. Two types of *G. davidsonii* were distinguished early, and one of these had hairier leaves and showed less jassid damage; the other type showed consistent discoloration of the leaf margins, but development was normal. Bollworm attack on both species was negligible, less than 1%, but when present, the larvae appeared to develop normally. They appear to be relatively unattractive to the pest, and this is confirmed by a count of red-bollworm larvae in November, 1948. *G. davidsonii* bolls showed less than 3% infestation, while a neighbouring patch of ratooned Kapas Purao was 40% attacked.

A surprising number of natural hybrids, showing outstandingly vigorous growth, occurred. Five plants of *G. davidsonii* probably crossed with *anomalum* were sterile; one plant, obviously a hybrid, was fully fertile. There was also a hybrid among the *G. armourianum*, but it has so far produced no flowers.

It should be remembered throughout that observations were made on small unreplicated plots, and exposure to pests and diseases may not have been the same for all the species.

LABORATORY METHODS WITH COTTON.

As indicated in the programme of work, studies were continued as time permitted with a view to evolving more rapid methods of judging cotton hair properties. In view of the well established and widespread procedure of combing out the lint on a number of seeds to obtain an estimate of length, the investigations were directed to making use of these combed seeds for other measurements.

The development of a rapid method of determining hair weight per unit length was successfully completed and a descriptive note was written for publication (King and Munro, 1948). Trials indicated that, with practice, it was possible to obtain a reasonably accurate figure in as little as 20 minutes per strain. It has since been found possible to train a selected African employee to do the laying out, counting and rolling up of the hairs, leaving only the cutting and weighing for the cotton breeder himself. By this arrangement 30 bundles (representing duplicate samples from 15 single plants) were prepared for cutting during a day and the cutting and weighing of these was then completed in one hour. It may therefore be said that, when the material demands it, routine determinations of hair weight on really large numbers of selections are now possible.

In connection with the determination of immaturity, attempts to modify and speed up the microscopic differentiation into normal and dead hairs by the use of caustic soda met with only a small measure of success and were then abandoned in favour of trials of the differential dyeing technique described by Goldthwait (1947).

It has not been possible to carry these trials as far as hoped, but it may be said with confidence that the technique offers very great promise indeed of supplying a practicable method by which the cotton breeder may weed out the more immature lines in any body of related material.

In this connection a warning note has been sounded by the staff of the Shirley Institute that fineness as well as degree of maturity influences the dyeing process, so that selection based solely on this technique would tend to pick out either mature or coarse types. It is possible that the rapid determination of hair weights by the method referred to above would overcome this objection.

A further matter to which some attention was given was the quantity of lint lost from the seed in the process of combing. This is of obvious importance in connection with all subsequent hair character determinations based on the combed seed. It was found that the average loss actually occurring in the normal course of routine combing was, in some material, as high as 28%. This figure was at first considered to be most unduly high and to suggest extremely careless combing, but examination of combed seeds stored from previous seasons indicated average losses ranging from 24% to 29% for each of the last four seasons, and a reference to American work (Pressley, 1933) was later found which recorded a mean loss of 19%, with a range in most cases from 12% to 25%, rising to 50% when the combing was not properly done.

A trial was made of the possibilities of reducing this loss by selecting the more careful combers and by warning them to be more careful not to pull out hairs. Significant differences were found between combers both before and after warning, and significant differences in reaction to warning. Over all combers the effect of warning was to reduce the percentage loss from 20% to 13%, but the best improvement shown by any one comber was 18% to 10% and the worst from 23% to 19%.

Significant differences were also found between strains but these were not, as might have been expected, associated simply with lint length. In this trial, lint length measurements were not affected by the percentage of lint hairs removed in combing. This finding is supported by the American work already referred to, which showed that the hairs pulled out included all length classes.

It is thought probable that immature hairs predominate in the lint removed in combing but it has not yet been found possible to investigate this point.

ROTATION CROPS.

Good yields of maize were obtained, and a considerable surplus of grain beyond that required for consumption on the farm was available for sale.

The incidence of streak disease in susceptible strains of maize planted after November was again high ; December planted Hickory King showing a total of 91.3% infection compared with 3.8% in the resistant Peru $\times$ Hickory strain.

Knowledge of the value of the streak resistant P. $\times$ H. strain, developed on this Station, is steadily spreading, and requests for seed were again heavy. Some 4 tons 575 lb. were distributed without satisfying the demand.

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PROGRAMME FOR 1948-49.

With the transfer of Messrs. H. E. King and J. M. Munro to Nigeria and Tanganyika respectively, the resignation of Mr. C. E. Booth, chief field assistant, and the extra work involved in arranging the packing and transfer of equipment to the new Central Research Station in Uganda prior to handing over the Barberton Station to the Government of the Union of South Africa, it has become necessary to curtail the programme of cotton breeding work.

A variety test, to include some of the most promising strains of U.4 $\times$ Sea Island and M.U.8 $\times$ BP.52 plus control types, and totalling 16 strains, will be planted.

Some 8 acres of single plant selections and special bulks made in the season 1947-48 will be grown together with larger observation plots of other promising strains.

Further observations will be made on the wild cottons in relation to their reactions to diseases and pests.

A normal range of rotation crops will be grown and a considerable area of Peru $\times$ Hickory streak resistant maize will be planted to provide further seed for issue.

PLANT PATHOLOGY SECTION.

BY

G. M. WICKENS.

The season opened rather disastrously, violent storms with hail destroying most of the first plantings. This necessitated restriction of experimental plans, owing to limitations of quantity of seed available in a number of strains, with the following results.

All the Congo Triumph seed, kindly supplied by Mr. J. B. Hutchinson, and intended for inclusion in varietal test of reaction to *Nematospora gossypii* inoculation, was lost in the first planting. Acala W 29-4 and Acala W 29-6, kindly supplied by the United States Department of Agriculture, and stated to be resistant to *Verticillium* wilt, had to be excluded from the varietal test of reaction to this disease. The experiment designed to evaluate the reaction of a number of strains to spraying with *Xanthomonas malvacearum* (the pathogen of bacterial blight) had to be replanted on a small scale without replication. It included Stoneville 20, also supplied by the U.S. Department of Agriculture, and the following varieties supplied by Dr. R. L. Knight: Domains Sakel, BAR.14/1, X.A.129, BAR.11/2, SUS.12/4, BAR.12/3, SUS.7/2, BAR.7/1.

Seed supplies of all of the above, except Congo Triumph, have been increased by selfing in small plots planted for this purpose.

In partial compensation, later growth conditions were good. Apart from bacterial blight, generally much more prevalent than normal and sporadically severe, the incidence of pests and diseases which might interfere with the experimental programme was light. The portions of the Station on which plant pathological work was carried out fortunately escaped the heavy attack of bollworm mentioned in the Report of the Plant Breeding Section.

VERTICILLIUM WILT DISEASE.

Distribution, Spread and Carry-over of Infection.—Periodical mapping of wilt incidence in fields with a previously recorded wilt history has continued on the same lines as before. Also, the distribution of the disease over the whole Station has again been approximately mapped.

The following tables summarize analyses of wilt distribution in two plots. In plot 1 in the previous season, there had occurred, in well separated rows, plants diseased as a result of inoculation of the soil around the roots with *Verticillium dahliae*. In plot 2 there had been, similarly in well separated rows, plants diseased as a result of stem wound inoculation by this fungus.

Sites A are sites coincident with sites carrying in the previous season plants showing external symptoms of wilt as a result of inoculation.

Sites B are sites immediately adjacent to such sites in any direction.

Sites C are sites 2 plants removed from sites A in any direction, including knight's moves.

Sites D are sites further removed from sites A than sites B or C.

PLOT 1.

Sites.						Total.	No. infected.	% infected.
A	...	...	...	...	...	103	34	33.0
B	...	...	...	...	...	491	166	33.8
C	...	...	...	...	...	287	58	20.2
D	...	...	...	...	...	578	36	6.2
Totals	...	...	...	...	...	1,459	294	20.2

$\chi^2=137.1$

d.f. = 3

$P < 1\%$

PLOT 2.

Sites.						Total.	No. infected.	% infected.
A	...	...	...	...	...	160	27	16.9
B	...	...	...	...	...	515	105	20.4
C	...	...	...	...	...	380	50	13.2
D	...	...	...	...	...	369	23	6.2
Totals	...	...	...	...	...	1,424	205	14.4

$\chi^2=36.2$

d.f. = 3

$P < 1\%$

The χ^2 values have been calculated from the observed numbers of infected plants on the several sites, and the numbers expected on the hypothesis of no association between distributions of the disease in the two seasons. The hypothesis is disproved; there was a concentration of disease in the immediate vicinity of sites previously bearing diseased plants.

The main increase in disease in the second season, in both plots, occurred in areas adjacent to *Cassia siamea* windbreaks. This is in line with experience on the Station generally, and it now seems clear that likelihood of occurrence, survival, and increase of the disease, on this Station, is greater in areas adjacent to the windbreaks than elsewhere.

Again this season, in all fields periodically mapped, there has been observed a tendency for aggregation of wilt disease into areas of relatively high incidence, generally closely associated with the sites of patches of disease in previous seasons, with elsewhere a relatively sparse and sporadic scatter.

The suggestion from previous seasons' observations that there is no appreciable neighbour-to-neighbour spread of infection in any one season, such as might be expected if spread by root contact were to occur, received further support in the season under review. In this season it was possible to continue recording over an uncommonly long period (up to 14 weeks from first recording).

It has also again been observed that high incidence of disease, and marked increase from one season to a later, occurred only in areas of good plant growth. In areas of relatively low fertility, where disease has occurred at all it has been sparse and sporadic, and has remained so in successive seasons.

In a field of approximately two acres, the following roguing treatments were applied in five randomised replications, with one additional plot of treatment 3, the plots being separated by barriers of densely broadcast sunn hemp, six feet wide.

1. Affected plants left *in situ*.
2. Affected plants, as they appeared cut off at ground level, and removed together with any fallen leaf from such plants.
3. Affected plants, as they appeared, pulled from the soil and removed, thus taking away much of the volume of root system as well as the above-soil parts of the plants, together with any fallen leaf from such plants.

Twice weekly, from the first appearance of disease until senescence was so far advanced as to make detection of external disease symptoms impossible, the incidence of disease was mapped over the whole area. At the same time, the roguing treatments were applied in their respective plots. Thus no plant showing external symptoms remained in the rogued plots for more than four days from the first onset of such symptoms, except for three exceptional occasions when, owing to unsuitable weather conditions, the maximum was seven days.

In only four plots was there appreciable development of disease—one plot each of treatments 1 and 2, and two plots of treatment 3.

In these, total disease differed rather widely, being most in one plot of treatment 3 and least in the other plot of this treatment, with the other plots intermediate. There was found no evidence that the roguing treatment had any effect on the total amount of disease or on the rate of development.

In order to determine the influence of these roguing treatments on disease incidence in a following season, treatments A, B and C as follows were superimposed on plots of treatments 1, 2 and 3 above respectively, at the close of the season.

- (A) Plants chopped out at ground level, or just below, and burnt, as in normal local practice.
- (B) Remaining plants similarly chopped out and burnt, together with sweepings of leaf and other plant debris on the soil surface.
- (C) Remaining plants pulled by means of plant pullers, designed and manufactured locally on the principle of nail pullers, then removed and burnt along with soil surface sweepings as in B.

Similar treatments, with the addition of D (plants pulled but surface debris not removed), have been also applied to plots of mapped wilt history in which no previous roguing treatments have been applied.

It is hoped that observations in the coming season will complete a sufficient body of data, collected over four seasons, to provide a coherent outline of the epidemiology of this disease.

Alternate host plants.—Hitherto, the only plant other than cotton locally observed to be affected by the same disease is the weed *Sida spinosa* L. Incidence of the disease in this rather common weed has been low, and no affected plants were observed in the past season. To this must now be added sunn hemp, naturally occurring infection by *V. dahliae* having been found in the barrier strips of this crop in the roguing experiment, only in the general area of relatively high incidence of the disease in cotton. In sunn hemp the incidence was light and late in the season (and there is no evidence that its occurrence in any way affected the roguing experiment itself). The symptoms are clearly distinct from those of *Fusarium* wilt of sunn hemp, which, as usual, occurred with general distribution throughout the crop. In *Verticillium* wilt of sunn hemp, there was rather patchy bright yellow

leaf chlorosis, with flaccidity of the affected leaves, and with light brown vascular discoloration and no external discoloration of stem tissues. In *Fusarium* wilt the leaves were flaccid and dull green in colour without chlorosis, and the vascular tissues discoloured dark brown to purplish brown, with tissue destruction spreading rapidly into the cortex causing similarly discoloured sunken streaks along the stem surface.

Seed Transmission.—In further examination of the possibility of transmission of wilt disease through the seed, 24 lots of seed were planted in 1-row plots of 37 hills each, in seven randomised blocks, each 1-row plot having on either side a control row of U.4/5143 seed taken from almost certainly wilt-free areas. To give these 24 lots of seed, seed of each of 12 lots was divided into two fractions, water-sinking, and water-floating but methylated spirit sinking. The 12 lots comprised seed of the following types : U.4/5143, A.2106, M.U.8A, BP.50/3, BP.52 and B.181, all from areas of heavy natural wilt infection : U.4/5143, BP.50/3 and B.181, all from plants infected as a result of wound inoculation : and U.4/5143, BP.50/3 and B.181, all from plants less severely affected as a result of later wound inoculation.

The land carrying this experiment was, so far as previous records showed, also wilt free.

Growth was good to very good ; yields were 290 lb. lint per acre in one half of the experiment, and 430 lb. in the other. In this experiment at least it cannot be reasonably argued that growth conditions may have been against visual demonstration of the presence of the disease.

No external symptoms of wilt disease were seen, save in one plant of one of the control rows.

These results, taken in conjunction with those obtained in the previous season, and considering also the results of studies on this question obtained elsewhere, demonstrate that transmission of *Verticillium* wilt disease of cotton through the seed is at least a very unlikely event.

Differential Strain reaction to Stem-wound Inoculation by Verticillium dahliae.—30 plants, 15 in each of two randomised blocks, of each of the strains B.181, BP.52, BP.50/3, U.4/5143, M.U.8A, A.2106, A.6446 (U.4 × Sea Island) and A.5805-06 (M.U.8 × Tidewater), were inoculated 72 days after planting by introducing into wounds at the bases of the main stems small pieces of potato saccharose agar culture of the causal organism of wilt, *V. dahliae*. To give maximum possible uniformity of material within strains, the 15 plants in each plot were selected as the best grown in the centre rows, the remainder being rogued out, similar treatment being accorded to the rows on either side which served as controls. Also, immediately before inoculation all plants were stripped of flowers and buds, leaving only buds too small to be removed without danger of damaging the growing points. This had the anticipated effect of increasing the reaction to inoculation, and emphasising the differences in susceptibility between strains.

The following table compares the yield of seed cotton per plant in inoculated rows with that in adjoining control rows in the several strains, data for the two blocks being combined.

Strain.	Mean yield seed cotton per plant (gms.)		% loss in yield.
	in 60 control plants.	in 30 inoculated plants.	
U.4/5143	151	7	95.4
M.U.8A	143	9	93.7
A.2106	171	6	96.5
BP.50/3	153	4	97.4
BP.52	112	61	45.5
B.181	122	98	19.7
A.6446	116	58	50.0
A.5805-06	98	35	64.3

Under the conditions of this experiment, U.4/5143, M.U.8A, A.2106 and BP.50/3 were all highly susceptible, B.181 was resistant, and BP.52 intermediate in reaction. These effects are parallel to those recorded in the previous season for the same six strains grown in a V.T. on naturally infected soil, although in the present case much more severe disease was induced. The hybrids A.5805-06 and A.6446 both show some resistance, although in the former, one parent (M.U.8A) is shown to be highly susceptible, and in the latter, one parent (U.4/8161) is probably highly susceptible also.

It should be noted that the relatively high yield per plant in control rows of the four susceptible strains is probably derived at least in part from reduced competition resulting from the severe effects of inoculation in the intervening rows. Modification of experimental design to avoid this effect will be necessary if more critical determination of the influence of inoculation on yield be required.

It is also of interest to note that, in the higher-yielding block, the uniformly resistant B.181 showed a greater proportional reduction in crop as a result of inoculation than in the lower-yielding block (26.6% as against 9.4%). This effect was also shown, though to a lesser degree, in the uniformly moderately resistant BP.52. Such comparisons have less significance in A.5805-06 and A.6446, owing to variability in resistance within these strains, as will now appear.

Fourteen days after the inoculation, most of the inoculated plants were showing symptoms, although none were seen on the eleventh day. The onset of symptoms was, in the more susceptible strains, characteristically sudden and severe. On the 35th day, by which time all inoculated plants (save one of U.4/5143, an obvious accidental escape) were showing symptoms, the plants were graded for severity of infection, severe symptoms being graded 4 and slight symptoms 1, with 2 and 3 intermediate, with the following results.

Strain.	No. of plants in grade.				Total.
	1.	2.	3.	4.	
U.4/5143	0	1	2	26	29
M.U.8A	0	0	2	28	30
A.2106	0	0	0	30	30
BP.50/3	0	0	2	28	30
BP.52	0	0	29	1	30
B.181	10	18	2	0	30
A.6446	4	7	15	4	30
A.5805-06	4	9	2	15	30

Clearly the two hybrids A.6446 and A.5805-06 differ from the remaining strains in having a wide variability in reaction.

In the hope of providing a more objective measurement of the effect of inoculation in individual plants, periodical measurements were made of height of main stem of all inoculated plants and of adjoining controls. Also, yields of seed cotton of inoculated plants and of adjoining controls were individually recorded in the four strains showing some resistance. The data have not yet been fully analysed, but from general inspection it appears that the erratic operation of other factors influencing yield of seed cotton in the field is too great for this measurement to be of much value as an index, *in individual plants*, of wilt susceptibility. Measurements of growth of the main stem appear more promising, save for the occurrence of "topping."

For reasons which need not be elaborated here, more confidence is now felt than hitherto in the method of artificial stem-wound inoculation as a means of providing a comparative measure of a plant's susceptibility.

The method as at present employed, while giving in uniform strains uniform results with a high degree of certainty, is however slow and tedious, and improvement in this respect is desirable.

Unfortunately a planting, made in a further attempt to find an equally certain but more rapid method, failed. This together with shortage of time and facilities, led to abandonment of work along these lines. It is hoped that such work may be possible in the coming season, but difficulties in obtaining some necessary tools persist.

BACTERIAL BLIGHT.

Field Experiments.—Most of the experimental work was necessarily restricted to one plot, comprising one row of 37 hills of each of the following strains: U.4/5143, M.U.8A, BP.52, B.181, Stoneville 20 T.341 (Resistant, from U.S. Department of Agriculture), A.6620 and A.6446 (both U.4 × Sea Island). The following resistant types (B_2B_2), each with its susceptible (b_2b_2) counterpart, (all from Dr. R. L. Knight) were also included: BAR.14/1 and Domains Sakel; BAR.11/2 and X.A.129; BAR.12/3 and SUS.12/4; and BAR.7/1 and SUS.7/2.

The plot was sprayed with bacterial inoculum (*Xanthomonas malvacearum*) from knapsack sprayers by the usual methods designed to minimise differential effects that might arise from inequalities in the operators, machines, and times of application, as follows.

- (A) 16th and 17th January, 1948 (53 and 54 days from planting): suspension prepared from young vigorous cultures on potato saccharose agar of a recent isolation of the bacterium.
- (B) 29th and 30th January, 1948 (66 and 67 days from planting): suspension prepared from dried infected leaf material, by Knight's method.
- (C) 23rd February, 1948 (91 days from planting): suspension prepared from cultures similar to that used on 16th and 17th January.

For spraying A, mean daily maximum and minimum screen temperatures ($^{\circ}\text{F}.$), total rainfall and mean hours daily sunshine were as follows.

1. In the week preceding the second day's spraying, 88.0° , 65.0° , $1.23''$ (spread over 5 days), 7.0 hrs.
2. In the week beginning 17/1/48, 77.9° , 61.3° , $1.32''$, 3.7 hrs.
3. In the following week, 83.7° , 60.9° , $1.56''$, 5.4 hrs

Conditions were thus, in the two weeks following spraying A, even cooler and with less sunshine than in the corresponding period after spraying in the previous season, and as was to be expected, the incubation period was still longer (9–10 days after the first day's spraying, as against 8 days). Nevertheless, while in the previous season no differences in reaction between resistant and susceptible types could be seen, in the season under review such differences were clearly apparent, although they were rather less striking than those seen at Shambat in the Sudan.

In the four strains of b_2b_2 genotype, leaf lesions appeared rather earlier, retained the characteristic oily appearance of early lesions for a longer period, and developed to greater size than those in the B_2B_2 strains. When fully developed, the lesions were lighter coloured in the susceptibles than in the resistants, and much more commonly showed bacterial exudate on the lower surface. These differences were more marked between Domains Sakel and BAR.14/1 (Egyptian strains) than within the other pairs (Upland strains).

The other strains all reacted similarly to the B_2B_2 strains, except BP.52, in which the reaction was uniformly intermediate between the reactions of B_2B_2 and b_2b_2 strains. Lesions were noticeably sparse in M.U.8A.

Confirmatory results were given by the later spraying with leaf inoculum (B), and also by a spraying with pure culture suspension applied, on 26th and 27th of January, 1948, to six-plant plots of these strains on a plot of ground with watering facilities on another farm, very kindly placed at my disposal by Mr. A. N. de Maine.

No leaf lesions were seen to develop as a result of the final spraying C, which was followed by weather cooler than that following any of the earlier sprayings.

Neither the blackarm nor the bacterial boll rot phases of the disease developed to any appreciable extent in any of the strains in this experiment. Domains Sakel and its resistant counterpart BAR.14/1, both very poorly grown, were, as far as could be judged, about equally and moderately affected by blackarm. Accurate comparison between these and the very well grown Upland strains was not possible. Among the latter, all were slightly and about equally affected, except X.A.129 which was judged to be rather more affected than the rest. It was not possible to find any indication that, in the bacterial boll rot phase, strains carrying B_2 were less affected than their susceptible counterparts.

Owing to lack of replication and the advantage accruing to some strains through adjoining the poorly grown Egyptian strains, yield differences in this experiment are of no significance as indicators of degree of damage by *X. malvacearum*. The three rows of Upland susceptible types, none enjoying the advantage of freedom from normal competition, each gave yields of about 367 lb. lint per acre, while under the same circumstances the yield of M.U.8A was as high as 530 lb. Under Barberton conditions therefore, good yields may be obtained, even from susceptible types, in spite of the presence of abundant infestation of the pathogen.

All the plants in a similar adjoining block, set aside primarily for the building up of seed stocks, were inoculated, 70 days from planting, by needle puncture in the uppermost internode of the main stem, with bacteria from cultures contemporaneously demonstrated to be pathogenic to leaf tissue. Only very few were successful, so that no demonstration was given of varying susceptibility to direct blackarm attack between strains.

Field Observations.—These were again in marked contrast to the generally rather negative results of spraying. Sporadically, severe damage resulted from blackarm and bacterial boll rot, not only in hybrid progenies of U.4 $\times$ Sea Island and M.U.8 $\times$ Tidewater, and in the susceptible Kapas Purao, but also in strains expected to show resistance, e.g. M.U.8A. Thus for example in one field of M.U.8A there was observed sporadically, eight weeks after planting, severe leaf attack, mainly along the veins, causing the young leaves to be markedly distorted and stunted in development. Three weeks later, considerable blackarm had developed, and it was particularly noted that in no case was the origin seen to be the extension of leaf lesions down the petiole, as has been stated to occur frequently both in Uganda and in the Sudan Gezira.

Another apparently anomalous observation was made in adjoining plots of X.1730A and BAR.1730L, in both of which the general level of blackarm infection was moderate, save for two plants of BAR.1730L in which infection of all branches was severe enough to destroy all fruiting.

In a plot of wild cottons, *G. armourianum* was rather severely attacked by blackarm, and *G. stocksii* moderately. Attack was very slight to nil in *G. raimondii*, *G. anomalum*, and *G. davidsonii*.

Bacterial boll disease was noted to be particularly severe in A.5805-06, an M.U.8A $\times$ Tidewater hybrid.

The experimental work and general observations made at Barberton over the past two seasons have thus given a number of apparently anomalous results. These results are, however, not necessarily conflicting amongst themselves, nor in conflict with those of the work carried out in the Sudan. Where differences in leaf reaction between strains to spraying with the pathogen at Barberton

have been observed, they have been in the same direction as found in the Sudan. Apparently conflicting field observations, especially those of severe blackarm attack at Barberton in resistant strains, have been made under conditions of natural infestation, no doubt sporadic in its distribution. While such observations do demonstrate that resistant strains may under certain conditions be severely affected by blackarm, there is no reason to suppose that under exactly the same conditions susceptible strains would not have been still more severely attacked.

The failure of repeated heavy sprayings of inoculum to cause any appreciable amount of disease is indicative of failure to ensure contact between host and parasite under conditions of suitable physiological state of the host and of suitable environment. The occurrence of the necessary combination of factors under conditions of natural infestation, but not in experimentally sprayed plots, has apparently been observed not only at Barberton but also in Uganda, Tanganyika and Nyasaland (see E.C.G.C. Reports from Experiment Stations, season 1946-47). No explanation can as yet be offered, for, as far as is determinable from literature available here, very little study has been made of the epidemiology and pathology of the disease, particularly in its blackarm and bacterial boll rot phases. Such studies are now clearly necessary, not only to provide knowledge of relevant environmental, physiological and pathological factors to enable breeding and selection work to proceed unhaltingly in such regions, but also in that they might lead directly to practicable methods of reduction of damage from this cause under conditions of African peasant agriculture.

INTERNAL BOLL DISEASE.

Earlier work, outlined in reports for the previous two seasons, has been followed up by an experiment in which the following measurements have been made in nine strains; U.4/5143, U.4/6250, C.9363 (Cambodia), A.2106 (Cambodia $\times$ U.4), M.U.8A, A.5805-06 (M.U.8 $\times$ Tidewater), BP.50/3, BP.52 and B.181:

- (A) Severity of staining as a result of inoculation by *Nematospora gossypii* at four weeks of age, as measured by percentage loss in weight at maturity of the inoculated locks as compared with uninoculated control locks in the same bolls. (The bolls were bagged throughout development to prevent access of insects).
- (B) Percentage dry matter of parallel locks from bagged bolls of the same age taken at the same time, as a measure of physiological age at inoculation.
- (C) Mean maturation periods of bolls, parallel to the above except not bagged, the maturation period being taken as time from flower to boll splitting.
- (D) Rate of fruiting, in adjoining rows of plants not disturbed by inoculations and boll sampling.

Six separate samples, from two randomised blocks and three successive flower taggings in each, were obtained to give data on A, B and C. Two samples, from the last flower tagging, have not been employed owing to considerable immaturity in some of the strains. From the four samples providing data for analysis, A.5805-06 data have necessarily been omitted owing to excessive smallness (amounting in one instance to complete lack) of samples, due largely to exceptional damage from bacterial boll rot occurring in this strain.

Analyses of A, B and C are summarized in the following table.

Strain.			
	A.	B.	C.
	Mean percentage loss in weight as result of inoculations.	Mean percentage dry matter at time of inoculation.	Means of mean maturation periods (days).
M.U.8A	34.7	17.1	64.7
B.181	46.9	13.7	72.0
BP.52	49.3	13.7	71.7
C.9363	49.4	13.6	72.1
U.4/6250	51.1	13.9	69.3
BP.50/3	52.3	13.3	74.3
U.4/5143	52.8	13.4	72.2
A.2106	60.5	12.9	78.1
Sig. diff.	7.22	0.887	2.29

The highly significant variance ratio for strain differences in percentage loss in weight due to inoculation (8.40) is reduced to a non-significant value when "adjusted" by covariance analysis separately with percentage dry matter at time of inoculation (1.75) and with mean maturation period (1.75), and reduced still further (1.075) in multiple covariance analysis with both independent varieties.

In this experiment, therefore, significant differences in degree of damage resulting from inoculation at one chronological age are entirely attributable to differences in rates of physiological development. M.U.8A does in fact pass through its vulnerable early stage of high water content more rapidly than the other strains, and A.2106 less rapidly. The practical significance of this fact, in relation to potentiality for escape from damage arising from natural infection in the field, is however still uncertain. For, while increased boll maturation rate should be advantageous in the race against stainer breeding, such advantage might be offset through selection of diet by stainers being based on physiological, not chronological, boll age.

The greatest likelihood of promoting potentiality for escape from internal boll disease thus at present seems to lie in the promotion of a steep fruiting curve (a factor in disease escape that has of course long been recognised).

The behaviour of the several strains in this respect is indicated by the data given in the following table. For each strain is given the mean number of days (mean of two plots) from planting to splitting of half of the bolls developed, as computed from graphs of numbers of split bolls at successive intervals of time. These figures represent, in effect, a summation of rate of putting on of crop and rate of boll maturation.

Strain.	Days.	Brackets surround strains not significantly differing from each other.
M.U.8A	153.5	
U.4/6250	160.5	
BP.52	162	
U.4/5143	162	
A.5085-06	168	
B.181	168.5	
BP.50/3	169	
C.9363	171	
A.2106	175	
Sig. diff. at $P = 0.05$ 4.5		

PROGRAMME FOR 1948-49.

Distractions imposed by the closing down of this Station and staff limitations will to some extent reduce the experimental work that can be carried out in the coming season, and the programme must thus be regarded as somewhat elastic.

Priority will be given to continued studies on *Verticillium* wilt, as follows, as it is judged that this will most fully make use of data obtained previously.

(1) Field studies of epidemiology.

(2) The relative reaction of a number of strains, including parental and hybrid material, to both natural infestation and artificial inoculation.

(3) The influence of compost, phosphorus and potash on disease incidence.

(4) Methods of artificial inoculation.

Studies on bacterial blight will probably be restricted to observations on the influence of compost, phosphorus and potash in all combinations, on the relative reaction of B_2B_2 and b_2b_2 strains to artificial inoculation by *X. malvacearum*.

No further work on internal boll disease is contemplated for the time being.

[Included by courtesy of the Southern Rhodesia Government.]

SOUTHERN RHODESIA.

SEASON 1947-48.

INTRODUCTORY NOTE

BY

G. S. CAMERON.

Chairman, Cotton Research and Industry Board.

It is advisable, from time to time, to look back and to take stock of the cotton position as it is to-day, in contrast with the position it held but a few years ago, and try to visualise its importance in the rural economy of the Country.

Measured by the number of bales of cotton produced year by year, one might be forgiven if one came to the conclusion that cotton-growing in Southern Rhodesia is a hopeless proposition, and not worth the time and money spent on trying to establish it as a major crop. Yet this conclusion would be wrong as well as short sighted. It is now becoming progressively realised that mixed farming in Southern Rhodesia lacks balance, because of the restricted number of crops grown on a field scale. Another crop is badly required in the rotation with maize and a green manure crop. Cotton is the only crop to fill the need, and it does so remarkably well, in that the yield of maize is increased by having cotton in the rotation. Being a row crop of medium height it gives man a chance to get at the land to keep it clean. At present price levels it gives a good financial return for the lint alone, while the seed provides one of the best, and much needed, concentrated protein supplements for feeding cattle. Another advantage discovered in recent years, which is not yet sufficiently realised, is the ability of cotton to clean up land which has become badly infested with eel worm. This in itself should commend cotton to tobacco growers, and no doubt it will do so in time. It is not a difficult crop to grow, but it does require Native African labour to pick it, and Native African labour is in exceedingly short supply. To overcome this difficulty it may be possible to use mechanical cotton pickers, but so far these have not been obtainable, although one trial outfit is on order from the United States of America. Should it prove a success then there is little doubt but that cotton growing will go ahead, and will take its rightful place in a system of balanced agriculture.

One other outstanding difficulty which has yet to be overcome is the prevalence of bollworms, particularly the Sudan and American bollworms. Their control is a problem which has yet to be solved, but a perusal of the following Progress Report gives one the feeling that the solution to this problem is making steady progress. If such is the case, we can confidently expect greatly increased yields which, in turn, will make cotton a more remunerative and therefore a more attractive crop to grow.

The possibilities of cotton as a cash crop for Native Africans has been very well demonstrated in the Mondoro Reserve, which is only one of many Reserves well suited to the crop. Its extension to other Reserves and Native Purchase Areas is the concern of the Department of Native Affairs, operating through its Native Agricultural Department. In this they have the co-operation of the staff of the Cotton Research and Industry Board, which is always ready to assist whenever technical advice or help is required.

It is becoming more evident that Rhodesian cotton has a better staple than is actually required for the local spinning mills, and this may decide the issue as to whether a shorter stapled but heavier yielding strain ought not to be grown throughout the country. Such strains are available, and in process of being multiplied, but at least one more year is necessary before a definite decision can be made.

The Development Co-ordinating Commission, under the Chairmanship of Sir Miles Thomas, has issued its First Interim Report, in which it recommends a cotton development policy closely allied to that of the existing policy of the Government through the Cotton Research and Industry Board.

COTTON RESEARCH STATION, GATOOMA. PROGRESS REPORT FOR THE SEASON 1947-48.

BY

A. H. MCKINSTRY.

Planting Period	...	...	...	17th—22nd November, 1947. Cotton dry planted. 29th November—2nd December, 1947. Cotton planted on rainfall.
Flowering	...	...	...	Mainly early February to late March, 1948, but with secondary peak in mid-April, 1948.
Picking ...	...	...	...	June—July, 1948.
Legal Uprooting Date	...	...	...	30th September, 1948.

METEOROLOGY.

Climatically, the main adverse characteristics of a difficult season were, firstly, a droughty period in the latter half of January and the first week of February and secondly, a prolonged period of rain, accompanied by much cloud, which commenced in the last week of February and did not end until early in April.

This January drought had a greater adverse effect upon the maize than the cotton crop, but the very humid conditions during the period late February to early April were harmful to the proper development of cotton, although they suited maize admirably.

The total rainfall for the period 1st November 1947 to 30th April 1948 was 28.04 inches.

At the Station, minimum temperatures during the winter months ranged mostly between 40° F. and 50° F., but they were seldom in the lower forties.

AGRICULTURAL SYSTEM.

Compost and Cotton.—Applications of compost at the rates of five and ten tons per acre markedly increased the yield of seed cotton per acre ; but in the same trial applications of potassium chloride at the rates of 200 lb. and 400 lb. per acre had little effect in increasing yield as compared with the control plots, to which neither manure nor fertiliser was applied.

As this is the second consecutive season in which the potassic fertiliser has failed to increase the yield of cotton, this treatment will be discontinued.

Rotation Value of Cotton.—Results from these trials, of which there were two, are slightly conflicting. In the trial on "contact" soil, maize following cotton which had received five or ten tons of compost per acre yielded about two to three bags* of grain per acre more than the no compost treatment ; but in the second trial, on Hartley red soil, the no compost treatment gave a slightly heavier yield, by about 80 lb. of grain per acre, than the five tons per acre compost treatment. There was no ten tons per acre compost treatment in the second trial. Maize yields in these trials ranged from about thirteen to sixteen bags per acre but in neither trial were yield differences statistically significant.

In general crop rotational practice on the Station, in the past season, the heaviest maize yields, namely 13.9 bags per acre, were obtained where maize followed cotton which had received about five tons of compost per acre. Furthermore, the yield of 10.8 bags per acre, from the maize following cotton which had received no compost, was also heavier than the yield of 9.5 bags per acre from the maize which followed groundnuts.

On balance, therefore, this season's results confirm the evidence of past years that the yield of maize is heavier after cotton, and especially cotton to which compost has been applied, than where the maize crop follows crops other than cotton in the rotation.

Grasses.—*Panicum Makarikari* has been planted in part of a twenty-five acre field which will form the first planted pasture on the Station. This grass yields well and is greatly relished by cattle.

Of the Napier fodder grasses the one from the Gold Coast gives the heaviest yields under cultivation ; while the Napier fodder obtained in 1948 from Nyasaland covers the ground more rapidly than other types on account of its stoloniferous habit of growth. A multiplication of the Gold Coast and Nyasaland varieties will be made next season.

* One bag = 200 lb. grain.

One of the principal aims in making a search for grasses suitable for cultivated pastures is to increase the stock-carrying capacity and also the amount of compost made and, therefore, the productivity per acre of land on the Station as a whole. There are certain areas of this land which, because of their relative position, or soil formation, are more suited to permanent pasturage than to arable farming.

The adoption of a policy of sown and managed pastures of better yielding capacity and quality than the indigenous veld demands the provision of suitable barns for the storage of hay and pens for the feeding of steers during the rainy season.

AGRICULTURAL PRACTICES.

Treatment of Cotton Seed.—Neither plant stand nor yield in cotton was increased by treating acid delinted seed before planting with either "Agrosan" or different powder preparations containing either 33 per cent. D.D.T. or 5 per cent. B.H.C. As this is the third season in succession in which no useful results have been obtained by applying these treatments, this trial will be discontinued.

A Comparison between Cotton Seed planted on Ridges and on the Flat.—Owing to poor stands, which were apparently caused by the stony nature of the ground, this trial was abandoned. The trial was planted at the suggestion of the Land Development Officer, Mondoro Native Reserve, who, in his experience, favoured the ridge cultivation as an agricultural practice by African farmers.

Pre-Planting Cultivation Treatments and the Maize Crop.—Maize was planted following an experiment aimed at destroying Sudan bollworm overwintering pupæ by applying different cultivation treatments in the winter months of 1947. As treatments, the land was (a) ploughed and rolled, or (b) tilled with a Fishleigh Rotary Cultivator, or (c) disc harrowed, or (d) left undisturbed. The difference between the highest and the lowest yields among the actual cultivation treatments was less than one bag (200 lb.) grain per acre at approximately a fifteen bag per acre level. On the other hand, the lowest yield recorded in the cultivation treatments, namely fourteen-and-a-half bags per acre, was greater by three-and-a-half bags per acre than the yield of maize where the soil was left undisturbed.

COTTON PLANT DEVELOPMENT AND CROP YIELD.

As indicated previously, part of the Station's cotton was dry-planted from the 17th to 22nd November, 1947, while the remainder of the crop was sown on rainfall from the 29th November to the 2nd December.

Brairding of the young cotton plants, whether from seed dry-planted or otherwise, occurred mainly during the first ten days of December. The resultant plant stands at the commercial spacing may be described as good to excellent.

The first flower squares on the more advanced plants were just visible in the first week of January, 1948, and the crop commenced to flower during the first week of February. The main flowering occurred in February and March, but wet-weather conditions made it difficult to record the magnitude of this flowering. As rains continued into April a secondary flowering peak occurred in this month, although little crop was gained therefrom.

The shedding of young flower squares before flowering, and of buds and young bolls during February and March, was due predominantly to bollworm attack. More precisely, from the time that the earliest flower squares became visible, in the first week of January, until the first week of March, crop loss due to bollworm attack was caused almost entirely by Sudan bollworm. This is the fourth season in succession that Sudan bollworm has destroyed much of the all-important early crop. After the first week of March Sudan bollworm was joined by American bollworm in the attack.

The crop matured mostly during May and June and was harvested in June and July.

Lint length and quality were poorer this year than in 1947, although moisture conditions during the growth of the bolls were very much better in 1948 than 1947, a year of very dry conditions. Seed soundness was also of a decidedly low standard in 1948.

Only about 55 per cent. by weight of the whole of the Station's 1948 crop was classified as unstained seed cotton, as compared with 90 per cent. of the 1947 crop. These results are supported by the following figures taken from an analysis of the crop grown by African farmers in the Mondoro Native Reserve. The seed cotton is bought on classification according to four classes, of which only two are shown below :—

<i>Seed Cotton</i>				<i>Percentage of Total Crop.</i>	
				1948	1947
Class I (the cleanest)	...	...	...	49%	91%
Class II	...	...	...	40%	6%
Total	...	...	...	89%	97%

Station Yields.—Final growth in the 1948 crop was more vigorous and taller than in 1947, but despite this the yields of seed cotton per acre were poorer. The lower seed soundness, and therefore seed weight, as reflected in the greater percentage of Class II seed cotton in the 1948 crop, probably accounted for the greater part of the difference in yield in favour of the 1947 crop.

The heaviest yields in the Main Variety Trial this year were about 120 lb. lint per acre as compared with 210 lb. in 1947 and 155 lb. in 1946.

Mondoro Seed Cotton Yields.—It is gratifying to be able to record that the 1948 cotton crop grown by African farmers, in the Mondoro Native Reserve, has again shown a substantial increase. The following

figures give a comparison of the results obtained in the past two seasons.

	1948	1947
Total number of African growers	624	107
Total number of acres of cotton	516	102
Mean yield per acre seed cotton	410 lb.	550 lb.
Mean cash return per grower	£8	£10
Total cash paid to growers	£5,167	£1,147

Furthermore, as in 1947, several of the growers of the 1948 crop received individually between £30 and £40 for their crop, grown on approximately one acre of land, and, in a few instances, the cash return received per grower was between £40 and £50. Class I seed cotton, the cleanest, was bought for 6.50 pence per pound in 1948, as compared with 4.75 pence per pound in 1947. The price to be paid to African farmers for Class I seed cotton of the 1949 crop has already been fixed at 8.25 pence per pound.

As elsewhere, a very big factor in encouraging cotton growing by Africans is the payment of cash over the counter for cotton as delivered by the growers at the buying posts. This service has now been accepted as normal practice in purchasing the crop in Rhodesia.

A progressive feature of cotton growing by Africans is that the Department of Native Agriculture permits the crop to be grown only by those Africans who are willing to adopt good farming methods, in the way of applying farm-yard manure to the land and practising specified crop rotations. These African farmers are known as "Co-operators."

It is reported that, owing to the desire to obtain money by growing cotton, there is a rapid increase in the number of native farmers in the Mondoro Reserve who are adopting proper methods of farming. The Co-operators are also realising that the yield of maize is increased when this crop follows cotton in the rotation, as it does in the rotational system adopted by them.

There is indeed little doubt that Mondoro Reserve is but one of several areas suitable for an expansion of cotton growing by African farmers. Responsibility for the main direction and organisation connected with this expansion must rest initially with the Department of Native Affairs.

With the current high prices paid for raw cotton, it is considered that the present time is particularly favourable for a sustained effort by the Department of Native Affairs to expand African cotton growing, and in so doing to utilise the technical knowledge and other services which are readily available.

COTTON BREEDING.

In the Main Variety Trial, as will be seen from the information in Table I, four Barberton varieties, which were among the top yielders in a trial in 1947, were compared with four Gatooma varieties.

Two of these latter, namely 12204 and 12405, are derivatives of U.4 × Cambodia crosses (the 7 C's), whilst 12437 is a selection from 9L34, the variety in commercial cultivation.

TABLE I.
MAIN VARIETY TRIAL 1947-48.

Ancestry of Varieties.	Varieties.	Yield of Lint lb. per acre.
(64/7/10 × Cambodia) × 64/7/10	12204	120
(64/7/10 × Cambodia) × 64/7/10	12405	97
64/V/No. 3	9L34	91
Barberton U4 × Cambodia	A2106	75
(Barberton U4 × Cambodia) × U4	A150	73
9L34	12437	71
(Barberton U4 × Cambodia) × U4	A255	69
Barberton U4 × Cambodia	A292	64

Difference required for significance at $P = 0.05 = 10$.

Compared with the leading Gatooma varieties, the Barberton varieties yielded poorly in the Main Variety Trial, as well as in other trials this season, one of abundant moisture during the crop-making period. It was noted that in plant habit the Barberton varieties grew tall and lax, in contrast with the Gatooma varieties, which were more compact, although the two 7 C's tended to be of a tall upright habit. This difference in plant habit between the Barberton and Gatooma varieties was masked in 1947, due to the severe drought conditions which then prevailed.

As a result of the past season's low yields, coupled with observations made on some of these Barberton varieties in seasons previous to 1947, they have now been discarded. Despite a careful search among them, no single plants of really desirable fruiting characteristics for Gatooma conditions have been found. The discarding of these varieties is regretted as they have very good hairiness and most desirable combinations of seed weight, lint index, and ginning percentage. In fact it seems probable that the heavy boll weights possessed by these varieties contribute greatly to their yield; but this desirable characteristic is of no advantage because as compared with the Gatooma varieties they lack sufficient fruitfulness under Rhodesian conditions.

Comparing the Gatooma varieties among themselves, the two 7C derivatives have, over the past three seasons, proved themselves superior in yield to 9L34, and more so to 12437. This latter is now discarded.

Consideration is being given to the multiplication of the seed of 12204 and 12405 with a view to issuing these varieties for commercial cultivation. The final decision to do so will depend on the results of a large-scale spinning test. It is quite evident, however, that 12204 and 12405 have shorter and not such good quality lint as 9L34. It is on account of their better yield that the two 7Cs will be bulked and possibly issued.

In attempting to improve yield, greater attention is being paid to selecting for higher values in seed weight and lint index, in combination with other desirable characters. In this respect, the 12204 and 12405 varieties, as well as certain families derived from 9L34, show an improvement on 9L34 itself.

Another character of Rhodesian cotton which it is sought to improve is the lint quality. Such improvement need not necessarily be allied to an increase in the present length of 1 in.—1½ in. staple, as there is an increasingly greater demand from local industry for this staple. As groups, the U4s and 7Cs are noted for their "harshness" of fibre. As a basis of the work to improve quality, certain quality crosses, which were made in the Sudan and at Barberton, form the initial material from which selections are to be made.

Again, in taking selections, greater attention is now being paid to plant types suitable, in habit of growth and also in quick leaf-shedding at senescence, for mechanical harvesting. There is a possibility that an International Harvester cotton picker will be available in time for the 1949 harvest season.

First observations on a small number of plants of *G. thurberi* and *G. armourianum* indicate that the former is more "at home" at Gatooma than the latter. Whereas *G. thurberi* has matured a crop of bolls, *G. armourianum* has, as yet, set no bolls, although it has borne a number of flower buds and, more recently, a few flowers. These cottons will be tested for their possible resistance to the bollworms, *Diparopsis castanea*, *Heliothis armigera*, and *Earias spp.*, when a sufficient number of plants are available.

It is of interest to record that one of the *G. thurberi* seeds gave rise to a Siamese-twin plant composed of two stems and, as far as can be judged, two distinct root systems, but with complete fusion of the stem tissues in the region of the hypocotyl.

It is also of interest to record that one of the *G. armourianum* seeds gave rise to a plant which is apparently a natural outcross. This plant has so far proved to be sterile; its identity will be further investigated in co-operation with Mr. J. B. Hutchinson.

COTTON PESTS.

Jassid.—This pest was very much more numerous in 1947-48 than in the previous three seasons. The larger jassid populations were engendered partly by the fact that there was a fair number of susceptible types among the heterozygous quality crosses, on which the pest bred rapidly.

As a result of the greater attack and damage by the insect, much discarding of susceptible and border-line material was possible.

The Bollworms: Sudan (*Diparopsis castanea*) *and American* (*Heliothis armigera*).—Sudan bollworm carries over from one season to the next very largely in the form of over-wintering resting-stage pupae, encased

in tough earthen cocoons. The main attack of American bollworm in cotton is begun by a generation of moths bred in maize. Sudan bollworm attack commences at the earliest stages of bud production by the cotton plants and lasts throughout the season, whereas American bollworm attack begins in force some five to six weeks after the commencement of flowering provided that the cotton has germinated not later than the earliest maize.

Early planting, good crop husbandry, and the breeding of early flowering and early fruiting varieties of cotton are the best known methods employed partially to evade American bollworm damage, while the early uprooting of the cotton plants after harvest, and a thorough pulverising of the soil of the lands in which the plants have grown, are the best known measures of reducing the carry-over of the Sudan bollworm pest from one season to the next. Neglect in applying the known measures to reduce the carry-over of Sudan bollworm largely nullifies the methods practised to minimise American bollworm attack. In fact, earliness of fruiting in varieties bred for this character seldom finds opportunity to express itself fully, owing to losses caused in the all-important early crop by Sudan bollworm.

More specifically, this past season, Sudan egg laying had commenced on the young plants by the time that these were about three weeks old ; and young larvæ were fairly easily found during the formation of the first young squares in January. The first fully grown Sudan larvæ were taken in the crop coincident with the beginning of flowering in the first week of February ; and by the end of this month, the larger sizes of larvæ were to be found easily. Subsequently, Sudan attack remained in force throughout the season, terminating in the winter months with the formation of the final fraction of overwintering pupæ. At the end of September the first recrudescence of the pest was indicated by a small amount of egg-laying. In chronological parallel with the Sudan attack the numbers of American bollworm larvæ in cotton were few until the second week of March. Thereafter the attack by this pest increased appreciably. The attack was moderate in intensity but prolonged in duration. The main attack by American bollworm in the maize crop, which commenced to tassel about the end of January, took place in February.

About 34 per cent. of the locks of mature bolls showed damage caused by bollworm punctures, as compared with the figure of 10 per cent. in the 1947 crop. Undoubtedly this threefold increase in bollworm damage to mature bolls could account indirectly for much of the higher percentages of discoloured lint and unsound seed obtained in the 1948 crop, as boll-rotting organisms gain entrance through bollworm punctures.

Counts of overwintering Sudan pupæ in unploughed cotton lands in August and September, 1948, showed that there were about 3,000 to 4,000 pupæ per acre, the vast majority of these being found distributed at random in the top four inches of the surface soil. Comparable figures in 1947 and 1946 were 2,500 and 24,000 pupæ per acre respectively.

Among the experiments of an exploratory character which have been in progress during the past two seasons, in an attempt further to control the Sudan bollworm, the following is a brief summary of those which, for practical purposes, have given negative results.

1. The trapping of the early Sudan bollworm moths' egg laying on leafy but largely non-fruiting photoperiodic perennial-type cotton plants in the November to February period.

2. The destruction of fifth instar Sudan larvæ, as they enter the soil to pupate for the winter, by admixing D.D.T. or B.H.C. preparations in the uppermost layer of soil.

3. The destruction of overwintering pupæ within their largely impervious earthen cocoons by injecting D.D.T. and other fumigants into the soil during the winter months.

Over the past two years, large-scale experiments to test the efficacy of different forms of cultivation treatments in the mechanical destruction of Sudan pupæ during the winter months (when the pest is in a dormant and immobile condition) have not given tangible results, in indicating a reduction of pupæ, when counts were made of these pupæ before and after treatment. This is due to the practical difficulties, amounting almost to the physical impossibility, of sampling adequately the pupal population formed *in situ* in the cotton lands. It seems reasonable to suppose, however, that the earlier and more thorough the pulverisation of the surface soil to a depth of 4 to 6 inches, the greater the likelihood of destroying, and therefore reducing the numbers of, Sudan overwintering pupæ. The following treatments were applied to the surface soil during the course of these experiments:—Ploughing and rolling, discing with disc harrow once, and twice, and rotary cultivating with a power-driven Fishleigh Rotary cultivator. Of these treatments, all factors considered, discing appears to have most in its favour as a method of destroying overwintering Sudan pupæ.

Cotton growers are being advised, therefore, to disc harrow the cotton lands immediately after uprooting the plants, soon after the picking of the crop has been completed, and further, to allow the soil in this disturbed condition to desiccate, in the hot-weather months, for as long as possible, before ploughing or in other ways preparing it for the planting of the maize crop, which follows cotton in the rotation. As indicated previously, the yield of maize planted after a double disc harrowing was, this season, less by about eighty pounds of grain per acre than that of maize planted after the more usual preparation of the soil by ploughing and rolling the land.

In other experiments, in which heavy types of rollers were drawn over land previously dug by hand hoe or disc harrowed, and then seeded, with Sudan pupæ, only about 20 per cent. of the pupal cells were crushed. In one such experiment the weight applied to the surface soil amounted to approximately one and a quarter tons over a width of eight inches. It seems unlikely, therefore, that attempts to crush or break the pupal cells lying in loosened soil by the passage of a dead weight such as a heavy roller would be successful.

Positive results have again been obtained, for the second season in succession, to the effect that applications of D.D.T. increased the yield of seed cotton per acre. This result is statistically significant in favour of D.D.T. in the form of an emulsion liquid, as compared with different types of D.D.T. wettable powders, as will be seen from the results in Table II.

TABLE II.
INSECTICIDES AND YIELD OF COTTON 1947-48.

Treatments. (See text for details of application.)								Yield of Seed Cotton in lb. per acre.
25% D.D.T. emulsion liquid	...	...	...	...	...	...	...	226
50% D.D.T. wettable powder	...	...	...	...	...	...	...	142
20% D.D.T. and 10% B.H.C. wettable powder	...	...	...	...	...	...	...	122
50% B.H.C. wettable powder	...	...	...	...	...	...	...	121
Not treated.	...	...	...	...	...	...	...	94
33% D.D.T. wettable powder	...	...	...	...	...	...	...	86

Difference required for significance @ $P = 0.05 = 76$

NOTE.—The wettable powders were not all from the same source.

In this experiment the programme as planned was to apply, for each insecticide tested, the equivalent of 1 lb. D.D.T. in 50 to 75 gallons of water per acre, depending on the size of the plants, at ten days' to fortnightly intervals, from the beginning of flowering until two months following. Rainfall considerably disorganised this programme, and it was possible only to apply the insecticide on the 16th and 26th February and, thereafter, not until the 10th April. Thus, because of rainfall, it was not found practicable to apply treatments either in the first two weeks of flowering early in February, or during the main flowering period in March. As the 11.55 inches of rain which fell between the 26th February and the 10th April was well distributed, with some heavy falls, it may be assumed that most of the 1 lb. D.D.T., applied on each occasion on the 16th and 26th February, was washed away, and therefore, the insecticide could have had little killing effect on either Sudan or American larvæ. Sudan larvæ were continuously present, but American were most numerous in March.

A factor which probably militated against heavier yields in this experiment as a whole was the fact that it was sited on the leeward edge of a field, where bollworm attack was greatest. Careful observation over the past three seasons has established that bollworm attack has been, in general, heaviest along the leeward edges of different fields, a fact which may be of importance in making maximum use of insecticidal applications in future.

Experimentation with insecticides is aimed at controlling not only the two major bollworms but all insect pests of cotton. In these experiments, no restrictions can of course be placed on the movements of bollworm moths, or of stainers, or of jassids, in their coming and going among the plots of different treatments. It is probable, therefore, that, because of these movements, records of pest populations in the different treatments have shown no clear cut differences. Indeed, because of insect movements, the design of field

experiments to compare insecticides of different composition, of different strengths, and of different times of application, is beset with difficulties.

Circumstances in the past two seasons have been very much against the insecticides' taking maximum effect. Despite this, results are sufficiently positive to warrant the planning of further, and probably larger-scale, insecticidal experiments next season, if facilities permit.

Spiny Bollworm.—Larval numbers were small throughout the season. But recent observations in September indicate that, apart from sparse egg laying by Sudan moths, Spiny bollworm in small numbers is the only pest to be found on the new growth of the old cotton plants, which by law have soon to be destroyed.

Cotton Stainers.—The first immigrant adult stainers were taken in the crop about the middle of February, and the first small nymphs were recorded towards the end of March. But adult and nymphal populations did not show an appreciable increase until boll maturation was in progress in May and June.

In numbers *D. intermedius* was slightly more numerous in the early stages of the attack, but *D. fasciatus* was the more prevalent later in the season. *D. supersticiosus* was rarely found.

Experiments on the trapping of the immigrant stainers on traps composed of cotton seed cake mixed with D.D.T. preparations were hampered considerably by wet-weather conditions in March. Abundant moisture induced a quick deterioration of the bait. But it was found that malthoid material could be moulded easily to form hollow cylinders, and these, used as a protective cover, increased the period of attractiveness of the bait. Further experiments with this type of trap are contemplated in the coming season.

Aphis.—This pest became quite prevalent in the last two weeks of February, and in intensity the attack was moderate.

Other Insect Pests.—The chrysomelid beetle *Monolepta* near *morio* Jac which appeared early in January in small numbers in one of the cotton fields, was killed easily by an application of D.D.T. wettable powder. In addition to *Lonchocarpus capassa* reported in 1947 as a host plant of the beetle, the insect was also found feeding in numbers on the common weed, *Portulaca oleracea* L.

Specimens of the weevil *Mimaulus testudo* Fhs. were received from the Mondoro area. Damage by this insect to cotton appeared to be restricted to a limited number of plants, in a few plots of African grown cotton.

The 1947 report of the Chief Entomologist states that the outstanding insect outbreak of the year was that of Army Worm *Laphygma exempta* Wlk. The peak period of the attack occurred in the Christmas-New Year week. The Station's maize crop suffered only a moderate

amount of damage from the pest in comparison with several farms in the vicinity, where losses in the first-planted maize were heavy. Having stocks of the newer synthetic insecticides on hand, it was possible for the Station's staff to do pioneer experiments in the initial stages of the attack with D.D.T. and B.H.C. preparations; and the information so gained later proved a valuable guide to officials of the Division of Entomology and Messrs. Pest Control Ltd. During the course of the attack a straight 0.5 per cent. D.D.T. in emulsion form, for use on plants, was found to be the best of the treatments tried.

MYCOLOGY.

Despite abundant moisture during a large part of the period of boll development, there was little evidence of external boll-rotting organisms. Neither did other diseases like angular leaf spot or *alternaria* cause much noticeable damage in the crop.

The increase in the past season in the amount of staining or lint discolouration, mentioned previously, is probably attributable more to the entrance gained by organisms responsible for such damage through holes and scars caused by bollworm damage, than by cotton stainers as vectors of internal boll disease.

SUMMARY AND CONCLUSIONS.

Adverse climatic characteristics of the 1947-48 season were a drought, mostly in January, and a prolonged period of rain accompanied by cloud, mainly in March.

Of insect pests, Sudan and American bollworms again were the main cause of much loss of crop, both directly by their feeding, and indirectly, in that boll-rotting organisms gain entrance through bollworm punctures. Wet-weather conditions favoured the activities of these organisms.

Application of D.D.T. in liquid form, for the second season in succession, again resulted in increased yields of seed cotton per acre. In neither season, however, were circumstances in favour of the insecticide's taking maximum effect.

Yield results in the Main Variety Trial confirm those of the two previous seasons, namely, that two 7C's are heavier yielders than 9L34. The former have not such good staple as 9L34, but their issue to commercial cultivation is imminent if the results of large-scale spinning tests prove favourable. Local industry is utilising an increasingly greater quantity of shorter stapled cotton.

It is thought that higher values in seed weight and lint index, in combination with other desirable characters, can be obtained, and this should result in an increase in yield. Such increase would, however, in no way compare with the greater increase in yield which would result if the two major bollworms could be subjected to effective control.

The application of farm-made compost has again proved beneficial in increasing the yield of cotton and also the yield of maize which follows cotton in the rotation.

The very marked increase in the amount of African grown cotton in the Mondoro Native Reserve area is but an example of what could be achieved in several other areas. The responsibility for sustained expansion of the African grown cotton crop rests with the Department of Native Affairs.

PROGRAMME FOR 1947-48.

Attention will be paid mainly to the following in the programme of experiments.

- (a) Control measures against bollworms.
- (b) Maintaining a high degree of jassid resistance in strains in conjunction with earliness, prolific fruiting, and desirable seed cotton characters.
- (c) Increasing the productivity per unit area of the Station lands as a whole, by expansion of grass-planting, cattle-fattening and compost-making activities, within the system of mixed farming practised, as facilities allow of such expansion.

ANGLO-EGYPTIAN SUDAN.

PROGRESS REPORT OF THE PLANT BREEDING STATIONS, SEASON 1947-1948.

BY

R. R. ANSON, R. L. KNIGHT, S. H. EVELYN AND M. F. ROSE.

PLANTING AND PICKING DATES.

Area.	Average Planting Dates.	Average Picking Dates.	Close Season.
Gezira	10th Aug.-15th Sept.	30th Dec.-1st April	31st May-10th Aug.
Gash Delta	20th Aug.-20th Sept.	10th Jan.-31st May	30th June-20th Aug.
Tokar	7th Sept.-15th Oct.	1st Jan.-31st May	30th June-1st Sept.
Kordofan	15th June-15th Aug.	1st Oct.-1st March	31st March-15th June
Zeidab	1st May-15th May	1st Sept.-31st Dec.	1st Jan.-30th April
Equatoria	15th May-31st Aug.	1st Oct.-15th Feb.	—

INTRODUCTORY NOTE.

This report covers the breeding and testing work on Egyptian cottons, at the Gezira Research Station, Wad Medani; the direct application of genetics to all cotton breeding problems, at the Shambat Sub-Station; and breeding and testing work at the Kadugli Sub-Station. In addition it includes a brief summary of work done at Zeidab on American irrigated cottons.

All work done on the American cotton varietal tests sited at Meridi in Equatoria Province was supervised by the Inspector of Agriculture (Meridi) and the details of this work are not at present available. However, a summary of seed cotton yields obtained from each variety under test is given at the end of this report.

The Plant Propagation Inspector, who works in close co-operation with this Section and is responsible for the propagation and segregation of promising new pure breeding strains, submits a separate report to the Director of Agriculture.

Buildings and Equipment.

During the season under review, five more roller gins have been added to the ginning factory at the Gezira Research Station. This small factory now carries two batteries of four gins. One of these batteries is fitted with an underground seed conveyor and is used for ginning bulk lots, the other battery has independent seed catchment trays and is capable of dealing with small samples of different varieties and small experimental tests, etc.

A seed cotton and cotton seed storage yard fitted with elevated white ant proof platforms is another new addition. It contains a concrete mixing floor and a small shelter for weighing machines, and is surrounded by a high barbed wire fence. This cotton storage yard supplies a long felt need and greatly facilitates work at the factory.

THE GEZIRA STATION.

METEOROLOGY.

The season opened favourably, with fairly early rains in May. Excellent stands were obtained at both Gezira Research Farm and Hag Abdulla, but at Turabi (varietal tests) and Fahl (early sowing date experiment with blackarm resistant material) the seed beds and general planting conditions were less favourable. Flea-beetle (*Podagrica puncticollis*) was troublesome throughout August, especially at Fahl, where it wiped out large patches and in some places necessitated a complete resowing. These resowings had to be continued until three weeks after the original sowing date.

Rains ceased early in October. There was a decided drop in night temperatures from November onwards. The average monthly readings were :—

Month.	Average Maximum.	Average Minimum.	Average 8 a.m. Humidity.	Total Rain, (m.m.)
April, 1947	106.70	72.86	25	—
May, 1947	105.98	73.58	34	48.8
June, 1947	105.26	75.92	47	22.1
July, 1947	99.14	73.94	66	46.7
August, 1947	94.10	72.50	76	97.6
September, 1947	97.16	72.14	75	27.9
October, 1947	102.20	72.32	51	7.2
November, 1947	98.06	63.14	33	—
December, 1947	97.70	61.52	43	—
January, 1948	92.30	56.84	35	—
February, 1948	95.54	58.10	20	—
March, 1948	99.50	63.32	15	—

EGYPTIAN COTTON SELECTION WORK.

BY

S. H. EVELYN.

BREEDING.

The selections were sown in Plot 56 on 12th August, 1947. This plot, although very convenient because of its proximity to the laboratories, has many disadvantages; it contains a fair amount of Nageel grass and its eastern side is affected by the root growth of near-by Acacia trees. Germination was excellent but an early and heavy incidence of flea-beetle necessitated considerable resowing especially in the Domains Sakel series. This was later followed by a severe attack of thrips. Blackarm, leafcurl and jassid damage also affected the plants, but, notwithstanding, some very interesting results were obtained. Progeny rows, bulk progenies and "filters" of the commercial and blackarm resistant Domains Sakel and X1730A strains were observed, together with leafcurl and jassid resistant selections of both types.

The Domains Sakel Series (D.S. Selections).

Five of the nine progenies selected for low mean node number bred true and from the one with the lowest mean the six plants with the lowest node numbers were selected for further study. In view of the importance now placed on "grade" this selection for earliness acquires greater value, and so next season the blackarm resistant Domains Sakel and X1730 strains will also be selected for this character.

Many single plant selections, bulk progenies and filters of Domains Sakel were observed for regularity, improvement and further filtering. In future, however, work on Domains Sakel will be of minor importance in view of (a) the commercial success of D.S.1, now known as Evelyn's Sakel and (b) the appearance in the breeding plot this season, for the first time, of a blackarm resistant Domains Sakel. Work will be concentrated in future on these types.

This season, at Keteir Block, 4,888 acres of D.S.1 were grown commercially by the Sudan Plantations Syndicate and compared with main crop Domains Sakel at the adjoining Feteis Block. D.S.1 produced 13.5 per cent. more Grade I seed cotton, gave a higher yield per acre, and in G.O.T. was slightly higher in all grades. Its lint, though of the same class as commercial Domains Sakel, is slightly longer, stronger and finer and of greater regularity, especially in the top grades. Hair and spinning tests have shown its lint quality to be just slightly superior, and field and varietal trial observations have demonstrated that its susceptibility to blackarm, leafcurl and jassid is no greater than that of Main Crop. A propagation area of 4,800 acres of it was grown at the Gash this season and ginned at the Port Sudan Ginning Factory, where it received a very favourable report. The seed produced at the Gash will sow 30,000 acres in the Gezira next season.

BAR.14/1, the first blackarm resistant Sakel to be grown in the breeding plot, gave excellent lint and was selected and filtered this season. A small bulk plot of it at Abdel Magid gave a yield of over 1,890 pounds of seed cotton per acre. BAR.14/7—a further backcross product—will be available for observation next season. The D.S. parent used in the backcrossing was of very high lint quality and this character appears to have remained unaffected.

The X1730 Series.

Many selections, bulk progenies and "filters" of (a) X.1730K ($b_1b_1b_2b_2$); (b) BAR.1730L, L-1, L-2, BAR.4/5 ($b_1b_1B_2B_2$); (c) BAR.4/8, BAR.4/9, BAR.4/17 ($b_1b_1b_2b_2B_3B_3$); and (d) BAR.4/11 and BAR.4/16 ($b_1b_1B_2B_2B_3B_3$) were grown for analysis, selection and filtering. Selection within BAR.1730L, BAR.4/5 and BAR.4/11 is based primarily on yield and quality and already BAR.1730L-1 has, in the variety trials, shown itself superior to BAR.1730L in both these characters in spite of its seeds having always been of Gezira origin

and so inferior to that of BAR.1730L and X.1730A which have been of Gash origin. BAR.4/16, in its first season in the breeding plot, gave many plants of promise and these are being carried forward together with a "filter" of it.

This season 25 acres of early sown (1st August) BAR.4/5 was grown commercially at Fahl Block by the Sudan Plantations Syndicate and compared with an adjacent plot of X.1730A sown at normal date (mid-August). Dirty land, bad preparation, poor sowing and a severe attack of flea-beetle necessitated almost a complete replanting of certain areas and these conditions were probably responsible for the very poor grade of the BAR.4/5 which was subsequently obtained. There was little difference in yield. Hair and spinning tests on comparable samples, from variety trials, of BAR.4/5 and X.1730A have generally shown the former to be slightly superior in lint quality, although the cotton is of the same class. In the coming season, early sown (23rd July) BAR.1730L and BAR.4/5 will be compared commercially with X.1730A sown normally on 12th August, at Wad Naaman Block, Sudan Plantations Syndicate, in replicate pairs of fields, each of 90 acres. A spacing trial of these strains will also be sited at Wad Naaman Block to determine the effect of spacing on grade.

At the Gash, both BAR.1730L and BAR.1730L-1 will be bulked up in isolation next season.

SELECTION FOR LEAFCURL RESISTANCE. ~

The layout and technique followed in this work have been previously reported in former "Reports from Experiment Stations."

(a) *The Domains Sakel Series—Plot 56 G.R.F. (Sown 15.9.47).*—Four resistant selections R.D.S.1/47, 2/47, 3/47 and 4/47 and BAR.14/1, were tested against the commercial Domains Sakel this season. An acre of a bulking of the four R.D.S. strains was grown in isolation at Abdel Magid and showed very high resistance coupled with a good yield. The same bulk seed grown at Shambat, for the purpose of adding blackarm resistance, also showed very high resistance. BAR.14/1 was added to the experiment so that leafcurl resistance, if present in this blackarm resistant Domains Sakel, could be directly extracted and thus save the work involved in synthesizing, by backcrossing, a Domains Sakel resistant to both diseases. Following are the results of the experiment :—

MEAN % LEAFCURL INFECTION OF THE DOMAINS SAKEL SERIES.

Observation Dates. Recorded fortnightly from 15.10.47.	R.D.S. 1/47	R.D.S. 2/47	R.D.S. 3/47	R.D.S. 4/47	BAR. 14/1	Com. Dom. Sak.	Sig. Diff.
Mean % at 20.1.48 (end of flowering) ...	Nil.	2.0	4.0	Nil.	49.0	67.0	*** 16.0
" 31.3.48 (end of picking) ...	18.5	10.5	24.0	19.2	83.5	100.0	*** 16.8
" 30.4.48 (On secondary growth)	42.5	37.0	41.5	60.5	95.0	100.0	*** 19.9

NOTE: The experiment was cut back on 31.3.48. *** = Significance at the 0.01 level.

It will be seen from the table that the R.D.S. strains, though not differing in resistance from each other except after cutting back, showed a very high significant resistance when compared with commercial Domains Sakel and its unselected blackarm resistant counterpart—BAR.14/1.

The R.D.S. strains were also sown as progeny rows on 12th August and belted on each side with commercial Domains Sakel. The following hole-infection was recorded :—

LEAF CURL INFECTION IN PROGENY ROWS SOWN 12TH AUGUST, 1947. PLOT 56 G.R.F.

Strain.	Total No. of Holes.	Infection at 2.3.48.		Infection at 31.3.48		Infection at 30.4.48	
		No. of Holes.	%	No. of Holes.	%	No. of Holes.	%
Domains Sakel Control ...	25	25	100.0	25	100.0	25	100.0
R.D.S.1/47 ...	23	Nil.	0.0	2	8.7	9	39.1
R.D.S.2/47 ...	24	2	8.3	4	16.7	8	33.3
R.D.S.3/47 ...	23	1	4.3	6	26.1	6	26.1
R.D.S.4/47 ...	24	0	0.0	2	8.7	5	21.7
Domains Sakel Control ...	21	21	100.0	21	100.0	21	100.0

NOTE.—The plants were cut back on 31.3.48.

A major difficulty of this work has been that to encourage leafcurl disease the experiment has always been sown a month later than the normal sowing date, *i.e.*, on 15th September instead of on 15th August. From experience it is known that mid-September sowing in the Gezira gives short, coarse, poor grade lint and lower yield and for this reason it has been impossible simultaneously to combine the selection of resistance with lint quality. It was rather upsetting therefore to find that, on analysis, the lint of these highly resistant R.D.S. strains sown at normal date as progeny rows, and that of the R.D.S. bulks at Abdel Magid and Shambat, also sown at normal date, was shorter, coarser and off-coloured when compared with commercial Domains Sakel. The differences, though obvious, were not very wide and it would appear that selective differences are present in the material and plants showing these will be observed next season. In addition, a few of the BAR.14/1 plants showed high resistance and these are also being carried forward. Four plants of the commercial Domains Sakel Control did not manifest the disease until 17.2.48 and "selfed" progenies of these are also being included. A striking feature of the R.D.S. progenies is the very slight degree of infection manifested when some of the plants do get the disease. This feature was also noticed at Abdel Magid and at Shambat. A very noticeable difference observed in the analysis was the much higher lint indices of the resistant plants as compared with the susceptibles.

(b) *The X.1730 Series*—Plot 56 G.R.F. (Sown on 15.9.47).—In Plot 231, at G.R.F., last season, the writer observed a number of X.1730A plants showing a fairly severe attack of leafcurl disease. Fifty-three of these were selfed, and the resultant seed was used as "spreader" material this season in an X.1730 experiment laid out on similar lines to the one above. It will be remembered from past

reports that X.1730A has always shown very high resistance in the Gezira and at Tokar, whereas at Shambat, 40 miles north of the northernmost limit of the Gezira cultivation, it shows the same susceptibility that Domains Sakel displays in the Gezira, at Shambat, at the Gash and at Tokar. At Tokar, Domains Sakel was replaced by X.1730A in the 1935/36 season because of its susceptibility to leafcurl disease and since then there has not been a single recorded case of leafcurl in the X.1730A crops. As it is not known what constitutes the difference in behaviour of X.1730A to leafcurl in the Gezira and at Shambat, this experiment was designed to determine what degree of resistance was actually present in X.1730A and its BAR. counterparts when they were exposed to conditions favouring infection. The late Dr. Crowther had already demonstrated, at G.R.F., that September-sown X.1730A could get as high an infection as 35 per cent.

Each hole of the strains used in the experiment was surrounded by four holes of the X.1730A "spreader" material and the site was contiguous to the Domains Sakel experiment and completely surrounded by Domains Sakel "spreader" material. Fortnightly observations were made from mid-October to end-March without a single case of leafcurl being observed, even in the "spreaders," and so the whole experiment was cut back on 31st March and a further observation made a month later on the secondary growth.

The following surprising results were obtained :—

MEAN % LEAF CURL INFECTION IN X.1730 SERIES.

Observation Dates. Recorded fortnightly from 15th October.	X.1730A.	BAR. 1730L.	BAR. 4/5.	BAR. 4/11.	BAR. 4/16.	Significant Difference.	X.1730A Spreaders.
Mean % Infection at 30.4.48 ...	33.5	43.5	42.8	58.0	38.5	None	46.2
" " " " 19.6.48 ...	56.0	64.0	54.8	62.5	49.5	"	58.0

The results of the experiment seem to confirm that X.1730A and its blackarm resistant counterparts are highly resistant under Gezira conditions but can show a relatively high susceptibility when conditions for infection are favourable. They also suggest the rather disquieting hypotheses (a) that X.1730A may be a carrier of the disease without obviously manifesting it, though recently acquired evidence, by the Plant Pathologist at G.R.F., does not appear to support this view, and (b) that whatever constitutes the present resistance of X.1730A in the Gezira, might break down more easily, under certain conditions, than was originally thought. For example, the writer rather feels that had the more susceptible Domains Sakel "spreaders" been used instead of the X.1730A "spreaders," infection might have been obtained earlier. This will be done next season.

In view of these surprising results the percentage infection in the cut-back guard rows of this season's variety trials are recorded :—

% LEAF-CURL INFECTION IN CUT-BACK GUARD ROWS OF 47/48 VARIETY TRIALS.

	DOM. SAK.	D.S.-1	D.S.-2	X.1730A GASH.	X.1730A TOKAR.	BAR. 1730L	BAR. 1730L-1	BAR. 4/5	BAR. 4/11
Turabi (North) ...	87.8	85.3	70.3	1.0	0.0	0.3	0.0	0.0	0.0
G.R.F. (Centre) ...	37.5	31.9	42.1	0.0	0.2	0.7	1.0	1.5	4.2
H. Abdulla (South) ...	1.7	3.0	6.8	0.0	0.1	0.1	0.0	0.0	0.1
Average ...	42.0	40.1	39.7	0.3	0.1	0.4	0.3	0.5	1.4

It is of interest to note the " place effect " on infection.

WORK ON JASSID RESISTANCE.

Selection work on Hairy X.1530 continues. This strain, now called J.R.1530, when sown in alternate rows with X.1730A remains much greener under jassid attack, throughout the season, than the control and at the same time is very high yielding. It is now fairly pure for a lint index of 7.0 to 8.0 gm., a G.O.T. of 38 per cent. to 40 per cent. and a lint length equal to or longer than X.1730A. Spinning tests have shown its lint quality to be not inferior to X.1730A. A large number of selections are being carried forward.

J.R.14/5—a Domains Sakel strain to which the hairy gene of Tanguis has been added by backcrossing—was grown for the first time in the breeding plot this season alongside its Domains Sakel parent (D.S.1). An analysis of 300 random plants showed it to carry excellent lint, and this is very promising as it indicates that the main H gene can be put into Domains Sakel without affecting lint quality. As a check, however, lint samples of it and of the adjacent D.S.1 have been sent to the Shirley Institute for technological examination.

MISCELLANEOUS.

The hair and spinning test results of the Dated Flower series referred to in last year's " Reports from Experiment Stations " are recorded below. These confirm the excellence of the Sudan Plantations Syndicate grading of their seed cotton and suggest that the cotton breeders can best solve the very important existing grade problem by breeding strains that produce a much higher proportion of their crop in the early pickings than do the present commercial strains. It would seem from results that Evelyn's Sakel (D.S.1) carries this character. A large number of experiments have been designed for next season to try to determine what factors cause a good or a bad grade year, and much of the attention of the cotton breeders will be devoted to this very important problem. Following are the hair and spinning tests results of the Dated Flower Series :—

SHIRLEY INSTITUTE SMALL SCALE SPINNING TEST REPORT No. 152.
 SAMPLES FROM PLOT 231—GEZIRA RESEARCH FARM. SOWN 22.8.1946.
 COUNTS SPUN—80's : TWIST-FACTOR—3.5 : SINGLE TESTS.

	Flower Tagging Date	Date of Picking	No. of Days to Maturity	Fibre Tests					Corrected Lea Count Siren. Prod.	Yarn Appce.
				Effect. Length	% Short Fibre	Maturity N-D	Fibre Wt. per cm.			
							Mean	Stand.		
Commercial	22.10.46	4.1.47	75	50	30	70- 5	137	134	2196	F.G.
Domains Sakel	5.11.46	23.1.47	80	53	24	76- 3	148	139	2271	"
	19.11.46	6.2.47	80	49	27	59-10	132	140	2084	FAIR
	3.12.46	20.2.47	80	44	34	50-15	126	144	2123	POOR
	17.12.46	1.3.47	75	44	43	47-23	116	141	1890	"
	31.12.46	10.3.47	70	41	44	50-23	123	147	—	"
Commercial	5.11.46	28.1.47	85	51	38	72- 7	149	145	2102	F.G.
X.1730A	19.11.46	6.2.47	80	49	30	61- 7	149	154	1941	" FAIR V.P. POOR
	3.12.46	20.2.47	80	46	33	60- 7	151	157	1735	
	17.12.46	1.3.47	75	43	44	41-42	125	159	1544	
	31.12.46	10.3.47	70	41	42	51-19	126	146	1605	

$$N = \% \text{ Normal Fibres. } D = \% \text{ Dead Fibres : Maturity ratio} = \frac{N - D}{200} + 0.70.$$

Standard Fibre Weight = Mean Fibre Weight ÷ Maturity Ratio.

Differences in corrected product greater than 7 per cent. (duplicate tests) or 10 per cent. (single tests) can be considered statistically significant.

THE VARIETY TRIALS.

BY

R. R. ANSON AND S. H. EVELYN.

The variety trials were carried out this season at the usual sites—Turabi (North), G.R.F. (Centre) and Hag Abdulla (South) in the Gezira commercial cotton area. With the exception of Turabi, where the land was very low-lying and subject to waterlogging, conditions were, in general, normal. The following results were obtained:—

MEAN YIELDS OF SEED COTTON AND LINT IN POUNDS PER ACRE AND MEAN PERCENTAGE G.O.T.

	Turabi			G.R.F.			Hag Abdulla			Mean Yields		
	S/C	Lint	G.O.T.	S/C	Lint	G.O.T.	S/C	Lint	G.O.T.	S/C	Lint	G.O.T.
Domains Sakel ...	522	175	31.8	1478	465	31.5	1565	524	33.5	1198	388	32.3
" " -1 ...	504	162	32.1	1499	476	31.8	1613	544	33.7	1205	394	32.5
" " -2 ...	511	163	31.9	1482	477	32.2	1639	561	34.2	1211	400	32.8
X.1730A—Gash ...	663	244	36.6	1770	624	35.3	1696	628	37.0	1376	499	36.3
" " Tokar ...	665	240	36.0	1823	647	35.0	1680	626	37.3	1389	504	36.1
BAR.1730L ...	646	239	37.0	1639	591	36.1	1547	590	38.2	1277	473	37.1
" " -1 ...	524	193	36.8	1712	602	35.2	1655	620	37.5	1297	472	36.5
BAR.4/5 ...	383	204	35.0	1673	568	34.0	1605	572	35.6	1287	448	34.9
BAR.4/11 ...	548	192	35.0	1566	531	33.9	1518	538	35.5	1211	420	34.8
		***			**		*	***				
Sig. Diff. ...	N.S.	45.0	—	196.0	36.9	—	106.7	35.3	—	—	—	—

The results of these trials can be briefly summarized:—

- The D.S selections did not differ in yield from Domains Sakel.
- Gash and Tokar X.1730A are identical in seed cotton and lint yield, and in G.O.T.
- In seed cotton yields BAR.4/11 appears definitely inferior to X.1730 ; BAR.1730L was only significantly outyielded by X.1730A at Hag Abdulla.

- (d) In lint yields—BAR.4/11 and BAR.4/5 were definitely inferior to X.1730A ; BAR.1730L was only significantly outyielded by the Control at Hag Abdulla whilst BAR.1730L-1 was only significantly outyielded by the Control at Turabi.
- (e) The seed of BAR.1730L-1 and BAR.4/11 was of Gezira origin.
- (f) Lint samples have been sent for Spinning Tests.

ACKNOWLEDGEMENTS.

Acknowledgement is here given to the excellent work of Ahmed Eff. Abdel Rahman El Nur, Ibrahim Eff. Taha and Amin Eff. Hassan without which this full programme could not have been accomplished.

PROGRAMME FOR 1948-49.

The work will follow the same lines as in the previous season.

SHAMBAT STATION.

BY

R. L. KNIGHT.

INTRODUCTION.

This season the emphasis has still further moved from blackarm resistance breeding to breeding for jassid resistance. Much the same technique is being used in the jassid work as was employed in controlling blackarm. A number of hairy types belonging to various species have been or are being examined genetically and such as prove to have a reasonably simple genetic control of long and dense hairs are being used as parents in transferences to Sakel.

Another interesting line is the transference of lint strength from *G. thurberi* to Domains Sakel. This extra strength has been successfully taken through three backcrosses to Domains Sakel and third backcross plants showing considerably greater strength than V.135 have been again crossed with Domains Sakel.

METEOROLOGY.

Rains again started in May but finished in September, and the total rainfall for the year was only 3.2 inches. Again blackarm inoculations did not, in general, "take" as well as usual.

Temperatures were about normal and the season was characterized by a long cool winter which would have resulted in an excellent out-of-season crop had it not been for the heavy attack of leafcurl experienced this year. In the period 1st May, 1947, to 30th April, 1948, inclusive, there were 231 days when the shade temperature registered 100° F or over, 35 days with 110° F or more, and no day with a temperature of 115° F or over. These figures compare with 204, 35, and three days respectively, representing the average of the previous five seasons.

GENETICS AND BREEDING.

Production of Blackarm Resistant "Egyptian" Varieties.

1. *Blackarm Resistant Domains Sakel*.—About a third of an acre of Evelyn's Selected Domains Sakel (D.S.1) homozygous for the *hirsutum* resistance gene B_2 was grown at normal crop time. One acre was originally sown, which comprised progeny rows from a large number of resistant plants which had been selfed in the sixth backcross F_2 . The elimination of splitting progenies reduced this area to approximately one third of an acre. Seed from this area was sown out of season in a five acre propagation which yielded approximately half a ton of seed. This B_2B_2 strain has been given the number BAR.14/7; its detailed parentage* is:—

(Uganda B.31 $\times$ X.1530) $\times$ NT.29) $\times$ D.S.17.

In addition small propagation plots of similar parentage but of B_1B_1 and B_3B_3 composition were grown under the numbers BAR.14/11 and BAR.14/9 respectively.

It will be remembered that last season each of these three sixth backcross types was crossed with Evelyn's Leafcurl Resistant Sakel (R.D.S.). This season these three lines were twice backcrossed to R.D.S. R.D.S., however, has proved not to be identical with Evelyn's Selected Domains Sakel (D.S.1) in quality. Since the objective is to produce a typical D.S.1 which differs from its parent strain *only* in the possession of resistance to blackarm and leafcurl, advantage was taken of the season's high incidence of leafcurl at Shambat to select within BAR.14/7 for resistance to this disease. Accordingly, in the five acre propagation plot of BAR.14/7, two acres were selected as showing a high incidence of leafcurl. After the final picking three acres were cut out and these two heavily infected acres were rogued for leafcurl. 17,310 diseased plants were pulled out at this first roguing, leaving 3,847. These leafcurl free plants were then cut back hard to induce secondary growth thereby making any latent leafcurl manifest itself. These cut-back plants will be regularly rogued for leafcurl and such as remain after this will be bulk picked to be used as a first wave of partially leafcurl resistant BAR.14/7.

In the synthesis of a $B_2B_2B_3B_3$ type of similar parentage to BAR.14/7 material was sown in 1947-8 winter. Owing to a severe attack of leafcurl it is unlikely that this sowing will produce enough seed for a small propagation plot next season, and it is probable that propagation of this type will be held up a year.

In the transference of blackarm resistance from *G. sanguineum* (*G. arboreum* race *bengalense*, Silow) to Evelyn's Selected Domains Sakel, the gene B_4 was successfully carried to the tenth backcross to *barbadense* (sixth backcross to Evelyn's Sakel) and F_2 seed of this backcross was produced for sowing next season as a first step in producing a B_4B_4 Sakel type.

* As in previous reports, superscripts denote the number of times each strain has been used as a parent. The practice of writing the female parent first has not been followed, it being more convenient to write the donor parent first and successive backcross parents after it.

In a second transference from tetraploid *sanguineum* to Sakel a first backcross progeny of 75 plants was successfully grown. Thirteen of these plants showed partial fertility and second backcross progenies of these will be grown next season.

A transference from tetraploid *herbaceum* (Wagad 8) to Sakel gave a first backcross progeny of only five plants, but one of these, showing very marked blackarm resistance, on being regularly pollinated with Sakel pollen, has yielded 50 seeds.

Work on crossing the perennial *barbadense* type Grenadines White Pollen with Sakel has reached the second backcross stage and third backcross seed has been produced for sowing next season. The resistance of this type appears to be due to a single gene with variable expression in the heterozygote. The relationship of this gene to B_1 , B_2 , B_3 and B_4 is not as yet known but check crosses have been made from which this information can be determined next season.

2. *Blackarm Resistant X.1730A*.—Three main blackarm resistant strains of X.1730 have been produced in bulk : BAR.1730L, BAR.4/5 and BAR.4/11.

The genotype and parentage of these is shown below.

Variety	Genotype	Parentage
BAR.1730L	B_2B_2	$(B.31 \times X.1530^4) \times X.1730G^3 \times X.1730H) \times X.1730A$
BAR.4/5	B_2B_2	$(B.31 \times X.1530^4) \times X.1730G^3 \times X.1730H^4$
BAR.4/11	$B_2B_2B_3B_3$	$(B.31 \times X.1530^4) \times X.1730G^3 \times X.1730H^5$

An analysis of all spinning tests to date shows these three strains to be identical with X.1730A in all respects with BAR.4/5 slightly superior (see last season's report, p. 62).

Turning to lint yields per acre, twenty-three replicated comparisons of BAR.1730L with X.1730A, seventeen comparisons of BAR.4/5 with X.1730A and nine of BAR.4/11 with X.1730A are now available. The averaged figures from these variety tests are given below.

		BAR.1730L	BAR.4/5	BAR.4/11
Variety ...	...	542	470	432
Control (X.1730A)	...	546	512	490

Clearly, under the conditions of test, in the relative absence of blackarm, BAR.4/5 and BAR.4/11 are inferior in yield to X.1730A whereas BAR.1730L is about equal to X.1730A.

It is pertinent at this stage to see whether this reduction in yield is associated with the transferred genes B_2 and B_3 or whether it has its origin elsewhere. Turning to the parentage of these three strains (above) it will be seen that in breeding BAR.4/5 the last four crosses were made to X.1730H "blood"; similarly BAR.4/11 carries 96.9% X.1730H "blood". In breeding BAR.1730L, on the other hand, the final cross was to X.1730A giving this type 50.0% X.1730A "blood."

X.1730H itself was not effectively on test in the Gezira variety trials until the hybridization which gave rise to BAR.1730L was

complete. X.1730H subsequently proved inferior to X.1730A in yield and there can be little doubt that the final single cross with X.1730A in the breeding of BAR.1730L is responsible for its improved yield.

In view of this it was decided to cross BAR.4/11 with X.1730A on a large scale, to backcross once to X.1730A and then self-out a $B_2B_2B_3B_3$ strain. Accordingly a number of plants of BAR.4/11 were crossed individually with a number of plants of X.1730A. Next season the F_1 will be sown in alternate rows with X.1730A and again crossed plant to plant. This crossing will be done at Medani since blackarm grading will not be required at this stage. Seed of this cross will be sown out-of-season at Shambat and from this will be bred a typical X.1730A carrying B_2 and B_3 .

3. *Flagging blackarm-resistant X.1730 with the arboreum gene for red flowers and leaves.*—Red resistant X.1730 is being stored pending the successful establishment of a blackarm resistant X.1730 strain as the commercial type for the Southern Gezira. Two crosses from the red X.1730 to the commercial blackarm-resistant X.1730 should be adequate to transfer the *arboreum* gene for red flowers and leaves.

Production of Blackarm-resistant Strains of American Upland for the Southern Sudan and the Examination of Imported Upland types.

1. *Blackarm-resistant Uganda SP.84.*—BAR.SP.84 has been accepted as the commercial type for the rain areas of the Southern Sudan and next season the whole Nuba Mountains district will be under this type as, also, will be the cotton areas of Equatoria.

BAR.SP.84 is homozygous for B_2 , and this under most conditions gives an adequate protection against blackarm. In a bad blackarm year, however, there would probably be an advantage in having a greater resistance. Accordingly the *punctatum* gene B_3 was transferred to BAR.SP.84 and a small propagation plot of the B_2B_3 type was grown last season under the number BAR.7/7. As this strain did not appear true to type a later backcross was bulked this season under the number BAR.7/8.

2. *Blackarm-resistance of imported Uplands.*—Seven types were sprayed with blackarm inoculum and graded for resistance, this season, viz. KP.28, L.S.S., Victory, 216F, 199F, 244F, and 268F. Of these, 216F consisted largely of susceptible plants but carried about 20% of plants showing typical B_2 resistance. L.S.S. carried about 2% of susceptible plants, some 8% of plants showing resistance similar to that shown by B_2 in Upland types, and 90% of plants showing resistance equal to or better than that to be expected from a B_2B_3 combination. Victory, 268F, 199F, and KP.28 were homogeneous for a degree of resistance equal to that conferred by B_2 and B_3 combined. 244F was in general more resistant than a B_2 Upland but less resistant than the others.

A rapid survey of the nature of resistance in these Indian types and in Uganda KP.28 is being made next season.

Bollworm Resistance.

At Shambat, only Pink bollworm (*Platyedra gossypiella*) and Egyptian bollworm (*Earias insulana*) occur to any appreciable extent. As previously recorded, *G. armourianum* and *G. thurberi* show marked resistance to both these bollworms and it is this resistance which an attempt is being made to transfer.

1. *Gossypium thurberi* crosses.—This season one acre of *thurberi* × Sakel hybrids was grown, the families being plentifully interspersed with Sakel controls. These families were of two types.*

Family No.	Parentage
PE.1—22/47	<i>G. "thurbadense"</i> × Domains Sakel ² F ₂
PE.23—40/47	<i>G. "thurbadense"</i> × Domains Sakel ³ F ₁

A heavy bollworm attack was induced by sowing six acres of American Upland alongside the plot some eleven weeks before the bollworm plot was sown. When the bollworm plot was flowering freely the American cotton, which by then had a heavy bollworm attack, was cut and left lying. In addition, baskets of bolls were picked from the early sown American crop and broadcast in the bollworm plot.

None of the forty progenies showed any appreciable bollworm resistance and from this it may be concluded either that the bollworm resistance of *thurberi* cannot manifest itself in a New World tetraploid cotton or that not enough parents had been selected in the previous generation to give reasonable certainty of including resistant ones. Of these possibilities the former seems the more likely.

2. *G. armourianum* crosses.—This season large backcross progenies of the following composition were grown :—†

Family No.	Parentage
PE.41/47	<i>G. "armadense"</i> × Domains Sakel ² F ₁
PE.47/47	<i>G. "armadense"</i> × XA129 ² F ₁
PE.42—46/47	<i>G. "armadense"</i> × Domains Sakel ³ F ₁

In the first of these progenies, PE.41/47, 161 plants were raised of which 51 showed a variable measure of fertility and 110 failed to set a single boll. Several of these 51 plants appeared to carry bollworm resistance and these were backcrossed to Domains Sakel.

The second progeny, PE.47/47, is similar in parentage to PE.41/47 except that the last two crosses were made to American Upland (XA.129) instead of to Domains Sakel. The family consisted of 23 plants of which 10 showed varying degrees of fertility. Two plants appeared to carry marked bollworm resistance and these were again backcrossed to American Upland.

* *G. "thurbadense"* is a hexaploid made by doubling the cross *G. thurberi* × *G. barbadense* (Domains Sakel).

† *G. "armadense"* is the hexaploid made by doubling the cross *G. armourianum* × *G. barbadense* (Sakel).

In families PE.42-46/47 only the last, PE.46/47, appeared to carry any worthwhile degree of bollworm resistance. Several partially resistant plants were selected for further backcrossing.

Jassid Resistance.

As noted in previous reports, the objective in this work is to transfer, to Sakel, genes for hairiness from a range of types, and then to test their efficiency in various combinations. The economic background of the work is the damage caused by jassids in the Gezira. Damage by these insects is already serious on some 70,000 acres and less severe on a further 50,000. The extent of the loss in crop can be gauged by the fact that a single spraying with 0.1 per cent. D.D.T. on an area of some 600 acres gave an increase in yield of 40 per cent.* At present (1948) cotton prices jassids would be costing the Sudan not less than £500,000-£1,000,000 were it not for the partial control obtained by spraying vast areas with D.D.T.

A detailed genetical analysis of the inheritance of leaf hairiness in the following varieties of cotton has been undertaken :—

G. barbadense types: Tanguis and Carpulla.

G. hirsutum types: MU.8B, Philippines Ferguson and Kapas Purao.

G. hirsutum var. *punctatum* types: Kawanda *punctatum*.

G. hirsutum var. *marie-galante* types: St. Ignatius.

G. tomentosum.

The hairiness of *G. tomentosum* is controlled by a single gene, H_2 , unaccompanied by minor or modifying genes. In each of the other seven types the genetic mechanism consists of a main gene conferring hairiness accompanied by minor and modifying genes increasing the length and density of the hairs. In Carpulla, MU.8B and St. Ignatius this main gene has been shown to be identical with H_1 , the main hairiness gene from Tanguis. The H genes extracted from the other three types have all been crossed with H_1 and by next season it will be known whether or not they are identical with it.

The most valuable types, from the point of view of transferring jassid resistance to Sakel, are those in which length of hairs is attained by means of one or a few modifiers working on H_1 (or on an unidentified H gene). MU.8B, Philippines Ferguson and St. Ignatius come into this category.

In transferences from MU.8B the full parental hairiness has been extracted by selfing the first Sakel backcross and carried to the second backcross. Similarly in the Ferguson transferences an excellent degree of hairiness has been extracted from the second Sakel backcross and again backcrossed.

The method of transference has been to cross the hairy donor parent with Sakel, extract the maximum hairiness in F_2 and backcross to Sakel. In the F_2 of this backcross maximum hairiness is again selected for further backcrossing and selfing. Meanwhile, in each case

* Cowland, J. W. and Maxwell-Darling, R. C., 1946. Research Division, Dept. Agric. and Forests, Sudan Govt. Ent. Sect. Interim Report, 1945-6 (Duplicated).

the main H gene was transferred backcross by backcross without selfing out until later. As soon as this transference has gone through four or five backcrosses, an HH type is selfed out and used as a temporary backcross parent in the transference of the length modifiers. When the identity of any particular H gene with H_1 is established JR.14/5 becomes the backcross parent. JR.14/5 is Domains Sakel to which H_1 has been transferred by repeated backcrossing. Evelyn has examined JR.14/5 and has shown (p. 53) that the lint length has not been affected by the transfer of H_1 and that on all laboratory tests the quality remains unchanged. Spinning tests on this type are awaited.

Hairs on the under sides of cotton leaves are not the only possible source of jassid resistance. *G. armourianum*, though it has glabrous leaves, is markedly resistant or immune to jassids and, in crosses between *G. "armadense"* and Sakel, this resistance has been found to reappear in the first backcross. Further backcrossing has been done with a view to transferring this valuable character to commercial Sakel.

Other Investigations.

1. *Deciduous bractlet*.—The routine transfer of this character to Sakel and to BAR.SP.84 continues, but it is too early yet to say whether or not it can be freed from its subsidiary effects on boll shedding and on leaf abnormality.

2. *"Cluster" characters*.—The transference of "Egyptian Short Branch" to Domains Sakel was taken to the third backcross stage and self-bred seed from this third backcross is available for sowing next season. The gene is recessive and therefore requires selfing-out after alternate crosses to facilitate its transfer. The transference of the Upland character "Cluster" reached a similar stage.

3. *Transference of lint strength from G. thurberi to Sakel*.—Last season, lint from 33 plants of *G. "thurbadense"* $\times$ Domains Sakel² F_1 was sent to the Shirley Institute for preliminary strength tests. One of these plants (J.1129/46.4) was outstanding, having a Strength Index of 9.99 as judged by Pressley fibre strength tests. Lint of this plant showed an effective length of 49/32 in. and a standard fibre weight of 119. Apart from hair characters the plant was indistinguishable from Domains Sakel, in the field.

This season the seed of the backcross of J.1129/46.4 Domains Sakel was sown and 153 plants of *G. "thurbadense"* $\times$ Domains Sakel³ F_1 composition were raised. Lint of these plants was tested by hand and the 17 strongest lots were sent to the Shirley Institute for test. The three strongest plants in this group gave the following results:—

Plant No.	Strength Index	Mean Length (32nds)	Effective Length (32nds)	Hair wt.	
				Mean	Standard
PE.26/47.18	10.28	31	49	109	114
PE.26/47.23	10.44	34	50	109	107
PE.26/47.135	10.53	32	48	96	104
Domains Sakel	8.58	34	50	123	121

Further backcrosses have been made, this time using BAR.14/7, instead of Domains Sakel, as the parent and these will be sown next season.

This work has two possible uses. Firstly it gives a possibility of increasing the strength of Sakel by some 22 or 23 per cent. Secondly in jassid resistance breeding, should the addition of leaf hairs increase the fibre hair weight, this material, with standard hair weights of 104-107, would be useful for again reducing it.

Wild Gossypium Accessions.

Seed of *G. anomalum* was sent in from the Nahud Forest Reserve in Kordofan, by Mr. Smart, Inspector of Agriculture, Kadugli. Mr. Andrew, Government Geologist, sent in samples of both *G. somalense* and *G. anomalum*. These were collected in the following areas :—

<i>G. somalense</i>			
E. of Jebel Haraza ...	...	15° 14' N.	30° 35' E.
<i>G. anomalum</i>			
E. of Jebel Haraza ...	...	15° 14' N.	30° 35' E.
N.W. of Abyad ...	...	13° 51' N.	26° 18' E.
N. of Mellit ...	...	14° 14' N.	25° 41' E.

It is a pleasure to put on record my thanks for the co-operation and helpfulness of the many people in this country who have aided in tracing out the distribution of these wild species of *Gossypium*.

DISEASES AND PESTS.

Blackarm, *Xanthomonas malvacearum*, was, as usual, general during the rains.

Leafcurl was exceptionally severe, especially in the winter sown crop.

Pink and Egyptian bollworms were controlled on breeding plot areas by spraying with D.D.T. and Gammexane.

PUBLICATIONS.

Knight, R. L. The genetics of blackarm resistance VII *Gossypium arboreum* L. J. Genet. (in Press).

SUMMARY AND CONCLUSIONS.

About half a ton of seed of blackarm resistant Domains Sakel was produced, and with this it is proposed to sow 100 acres in the Gash next season. Selection for leafcurl resistance within this strain has been started on a wide basis.

BAR.1730L is known to be the equal of X.1730A in lint yield and in its fibre qualities. The question of the commercial replacement of X.1730A by this blackarm resistant counterpart is now ripe for consideration.

Next season the whole Nuba Mountains district will be under BAR.SP.84 as also will be the cotton areas of Equatoria.

It is thought to be unlikely that the bollworm resistance (Pink and Egyptian) of *G. thurberi* can be transferred to New World allotetraploid cottons; but there are indications that the resistance of *G. armourianum* may be transferable.

In breeding for jassid resistance, it has been shown that the key hairiness gene H_1 occurs in *barbadense*, *hirsutum* and *marie-galante* cottons. This gene, transferred to Sakel, has no effect on lint length nor any visible effect on quality. Spinning tests will be available, shortly, and these will show whether there are any deleterious effects associated with this gene. The full hairiness of MU.8B has been recovered from the first Sakel backcross and again crossed with Sakel while the bulk of the hairiness of Philippines Ferguson has been recovered from the second Sakel backcross and again backcrossed.

In the transference of lint strength from *G. thurberi* to Sakel, plants showing upwards of 20 per cent. greater strength than Sakel have been selected in the third Sakel backcross and used for further backcrossing.

PROGRAMME FOR 1948-1949.

All the lines of work shown in this report will be continued except that work on bollworm resistance will be discontinued for a year owing to lack of adequate laboratory accommodation.

KADUGLI STATION

BY

M. F. ROSE.

The first half of the 1947-48 season was difficult, and some apprehension was felt for the establishment of the dura and cotton crop. Rains broke in the middle of April followed by a precipitation of 192 mm. in May, a record since 1910. Such heavy rains in May are not favoured, for they usually portend a June drought with late planting conditions. Past experience proved correct and June was marked by scattered rains with hot drying winds. Although bulks were planted on June 22nd no experimental material was risked, the latter being held till July 3rd and 5th: even then soil conditions were not good and some material was maintained by hand watering. Mid-July rains, however, led to the establishment of fairly good stands of cotton, but much dura had to be replanted. August and September witnessed mild drought conditions and there was loss of valuable selfed material from the bottom crop. The figure of 146 mm. for the period August 1st-September 15th does not compare favourably with that of 344 mm. for 1946 and indicates the strain placed upon the plant prior to and at the commencement of flowering.

October rains were heavy (130 mm.) and a record for the area and these were responsible for the saving of the late dura crop and for the excellent yields of cotton finally returned: dura yields were below average (852 lb. per acre over all strains) the season generally favouring cotton rather than dura. In spite of these heavy late rains the season closed down rapidly and experimental material was cleared from the Kamina Farm by December 4th.

Relevant meteorological data are given in Tables 1 and 1A covering Kadugli itself and cotton locations in the Eastern and Western Jebels.

TABLE 1. RAINFALL (MM.).

	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total.
Kadugli, 1947 ...	—	—	10	192	93	161	116	94	130	—	796
" 1946 ...	—	—	41	35	157	94	259	120	71	6	783
" 1910-1946	2	1	15	76	125	152	157	138	81	6	753
Lagowa, 1947 ...	—	—	7	84	62	86	198	180	74	5	696
Talodi, 1947 ...	—	—	78	165	111	215	231	233	36	5	1,074
Kalogi, 1947 ...	—	—	32	43	92	145	118	143	48	—	621
Abu Gebeiha, 1947	—	—	23	81	4	114	89	123	102	—	536

TABLE 1A. TEMPERATURES (°F.).

KADUGLI, 1946 AND 1947.

	Mean Maximum.	Range.	Mean Minimum.	Range.
Period Resting, Dec.-May, 1946 ...	97.0	108.5-80.3	68.5	82.4-55.8
" " " " 1947 ...	98.8	108.1-69.1	67.3	82.0-56.1
Period Growth June-Nov., 1946 ...	89.4	102.6-74.7	70.7	73.6-56.7
" " " " 1947 ...	91.9	102.2-74.5	67.8	77.0-56.1

INHERENT AGRICULTURAL CIRCUMSTANCES.

Commercial Bults.—Except in the case of Abu Gebeiha total rainfall and distribution favoured the crop and general returns were well above average. Demand for seed far exceeded supply and this demand is likely to increase if the price of Grade I seed cotton be maintained at 85 P.T. per kantar (99 lb.). Table 2 gives estimated areas and yields of seed cotton for the 1947-48 crop.

TABLE 2.

				Acres Planted Estimated Area.	lb. Seed Cotton Estimated Returns.
Eastern Jebels	Abu Gebeiha ...	...	...	2,500	800,000
	Kalogi ...	...	...	2,500	1,200,000
	Talodi ...	...	...	7,000	2,400,000
Western Jebels	Kadugli ...	...	...	7,600	3,000,000
	Lagowa ...	...	...	2,600	1,000,000
Total ...				22,200	8,400,000

Average = 380 lb. per acre.

Propagation.—A small propagation area of 70 acres comprising BAR.SP.84 and BAR.7/3 (a derivative from BAR.SP.84 possessing high G.O.T.) was planted on the Abu Habi Scheme at Rahad and Semeiha: this area has not been listed in Table 2 above.

Areas Abu Gebeiha and Kalogi grew BAR.SP.84, areas Kadugli and Talodi Pump Scheme Strain, while Lagowa, a region always held suspect for seed adulteration and admixture, received Pump Scheme, NT.58/43 and NT.96/40. Kalogi and Abu Gebeiha should yield 13,300 lb. of cotton seed (BAR.SP.84) sufficient for planting an area of 66,000 acres in the season 1948-49.

If world demand be insistent and the present price to the cultivator be maintained there is no reason why yields for the Nuba Mountains crop of from 25,000 to 28,000 lint bales of 400 lb. should not be reached by the season 1949-50.

GENETICS AND BREEDING.

The breeding plot, planted on July 3rd, comprised the following families (i) 33 lots of BAR.SP.84 to form a new "type maintenance" nucleus; (ii) 27 lots of BAR.SP.84 for type improvement; (iii) 12 lots of NT.205; and (iv) 4 lots of Nyasaland together with a special bulk 6101 SB (ex Mz.561). All BAR.SP.84 material was derived from the "filter" of the 504 single plants taken from the parental bulk in 1946. Of these 60 lots (BAR.SP.84), 40 were sprayed with blackarm suspension on the 20th and 21st August and 1,384 plants were inspected and their "infection grade" assessed on September 1st. Frequency distributions were drawn up for each family and the position and dispersion were used as criteria for the final discarding of susceptible "splitters." Eight lots from (i) and twelve lots from (ii) eventually reached the laboratory for full analysis of hair characters.

The former group for "type maintenance" showed some irregularity and will be subjected to a third "filter" in the 1948-49 season.

Under the conditions of the present season, all BAR.SP.84 derivatives responded well and much valuable material is on hand for future selection work.

The 12 NT.205 lots again showed marked uniformity in the field and laboratory analysis from the previous season indicated homogeneity in seed characters. With the advent of BAR.SP.84 to the breeding plot (1947-48) and introductions from Zeidab and South Africa (1948-49) it has become essential to discard ruthlessly any material below standard whose variability has been exhausted by continued selfing and selection. To this end a Compact Family Block Experiment* was laid down on July 5th in which NT.205 was represented by the basic families A4, A6 and A9: each family consisted of five progenies and the family block was replicated nine times: the experiment comprised 135 rows, with five hills per row. The following characters were analysed: (i) field emergence percentage, (ii) stand, (iii) crude yield, (iv) adjusted yield, (v) ginning out-turn and (vi) lint length. Mean differences between families and between progenies within families were non significant and tests for heterogeneity in variance gave values of X^2 between $P = .2$ and $.9$.

This material will be bulked and tested against the parental strain in a small scale trial next season.

* Hutchinson, J. B. and Panse, V. G., Studies in Plant Breeding Technique. *Indian Journal Agric. Sci.*, Vol. VII, Part IV., Aug., 1937.

Of the five Nyasaland lots it would appear that selections from Mz.561 will eventually give material most suitable to local conditions. An attempt is being made to select from it an earlier, more open type with a higher ginning out-turn, at the same time retaining the valuable attributes of high yield, hairiness and lint quality.

VARIETY TRIALS.

The Main V.T. Kadugli and the V.T. Talodi were planted on the 3rd July and the 28th June respectively. The four picking dates ranged from October 30th-December 4th (Kadugli) and October 29th-December 8th (Talodi). At Kadugli intra-row spacing was 45 cms. and 90 cms., with inter-row spacing constant at 90 cms.: at Talodi both intra and inter-row spacing was constant at 90 cms. Relevant data are presented in Tables 3 and 4.

TABLE 3.
KADUGLI MAIN V.T. (SPLIT-PLOT LAY-OUT).

Strain.	Seed Cotton per acre (lb.)	G.O.T.	Lint per acre. (lb.).	Difference Required 5% level.
BAR. SP.84 ...	2,337	33.6	785 (119)	49 lb.
BAR. NT.205/43 ...	2,267	33.4	757 (114)	
NT.96/40 ...	2,228	33.0	735 (111)	
P.S.S. (Control) ...	2,219	29.8	662 (100)	
NT.205/45 ...	1,800	36.0	649 (98)	
Mean ...	2,170	—	718	
45 cms. intra row ...	—	—	778 (118)	20 lb.
90 cms. " " ...	—	—	657 (100)	

Points of interest from Table 3 are noted below :—

(i) The efficiency of the types under trial to produce, in a period of five months, a mean yield of lint per acre of 718 lb : this from an area of 1.5 acres.

(ii) In terms of lint per acre, the superiority of BAR.SP.84 over the Control, P.S.S.

(iii) In terms of lint per acre (over all strains) the superiority of the 45 cms intra-row spacing over that of 90 cms (18.4% increase).

(iv) The poor yield of the " quality " type NT.205/45 compared with that of BAR.NT.295/43.

It also noted that BAR.SP.84 gave the same response to spacing as did the other strains, confirming the previous year's view that waterlogging (1946-7) was the factor limiting the yield of this drought resistant type (cf. rainfall records August and September 1946 and 1947).

TABLE 4.
TALODI V.T.

Strain.	Seed Cotton per acre (lb.)	G.O.T.	Lint per acre (lb.).	Difference required 5% level.
BAR. SP.84 ...	791	33.2	263 (116)	17 lb.
BAR. NT.205/43 ...	754	32.4	244 (107)	
NT.96/40 ...	752	31.6	238 (105)	
P.S.S. (Control) ...	770	29.4	227 (100)	

HISTORY OF BAR.SP. 84 AND ITS COMPARISON WITH P.S.S.

Season.	Strain.	Location.	Area.	Yield lb. per acre S.C.	G.O.T.	Yield lb. per acre lint.
1944-5	BAR.SP.84 ...	Kadugli... ..	1½ acres ...	1,401	33.5	469
1945-6	BAR.SP.84 ...	Kadugli... ..	VT	980	33.1	324 S
	P.S.S. ...	Kadugli... ..	VT	1,008	29.0	292
1945-6	BAR.SP.84 ...	Talodi ...	VT	616	32.5	200 S
	P.S.S. ...	Talodi ...	VT	603	28.3	171
1945-6	BAR.SP.84 ...	Kadugli... ..	3 acres, 1 plant per hill.	878	34.0	299
1945-6	BAR.SP.84 ...	Meridi Site 1 ...	VT	1,112	34.3	381 T
	" ...	Meridi Site 2 ...	VT	1,035	35.1	364 T
	" ...	Kagulu ...	VT	894	—	— T
1946-7	BAR.SP.84 ...	Kadugli... ..	VT	2,029	32.6	662
	P.S.S. ...	Kadugli... ..	VT	2,115	29.4	621
1946-7	BAR.SP.84 ...	Talodi ...	VT	848	34.8	287
	P.S.S. ...	Talodi ...	VT	1,097	30.7	336
1947-8	BAR.SP.84 ...	Kadugli... ..	VT	2,065	33.3	688 S
	P.S.S. ...	Kadugli... ..	VT	1,914	29.3	561

T = Top of Trial.

S = Significant difference.

HAIR CHARACTERS.

	Effective Length.	Mat. Ratio.	Mean Hair Wt.	Standard Hair Wt.	40's Lea Product.	50's Lea Product.	H.S.C.	Pence per lb.
1944/45.								
Talodi, BAR.SP.84 ...	39	—	157	203	1,964	1,578	37	14.00
" P.S.S. ...	36	—	155	194	2,069	1,895	44	13.45
Kadugli, BAR.SP.84 ...	40	—	156	204	2,027	1,778	41	14.00
" P.S.S. ...	38	—	161	191	2,177	2,003	50	13.45
1945/46.								
Talodi, BAR.SP.84 ...	37	0.735	142	193	2,120	1,939	47	14.35
" P.S.S. ...	35	0.855	151	177	2,219	2,045	53	13.85
Kadugli, BAR.SP.84 ...	38	0.78	143	183	2,105	1,933	46	14.25
" P.S.S. ...	36	0.89	165	185	2,242	2,070	54	14.10
1946/47								
Kadugli, BAR.SP.84 ...	37	0.815	156	191	2,266	2,146	60	21.50
" P.S.S. ...	37	0.89	176	198	2,220	2,027	52	
			Mean Values.					
BAR.SP.84 ...	38.2	0.777	151	195	2,096	1,875	46	
P.S.S. ...	36.4	0.878	162	189	2,185	2,008	51	

General Notes :— (i) BAR.SP.84 (a) is very early (b) is blackarm resistant (c) is jassid resistant (d) has a high G.O.T. (e) is most suitable for harig cultivation owing to (a).

N.B.—Harig cultivation is increasing in popularity in the Nuba Mountains.

It is on the average longer in staple but more immature and neppy than P.S.S. Of all early types it is the best in yarn appearance but comes second to P.S.S. in this quality. Brokers' valuations favour BAR.SP.84 with a premium of 0.5d. per lb. over P.S.S.

(ii) P.S.S. (a) is late (b) is blackarm susceptible (c) is jassid susceptible (d) has a low G.O.T. and (e) is most unsuitable for harig and late planting.

Its lint is more mature than BAR.SP.84 and gives yarns of better appearance.

Final yield figures from variety trials enhance the value of P.S.S. Seed cotton of late types which is picked experimentally and recorded as third and fourth pickings would normally be abandoned by native cultivators migrating south to water.

COTTON DISEASES AND PESTS.

(i) *Blackarm* (*Xanthomonas malvacearum*):— Blackarm made its appearance on the Kamina Farm on August 5th and spread through susceptible material. Counts were made on the Main Variety Test from August 27th to September 1st. As there was no significant difference in terms of mean grade infection between the two spacings for a variety, the figures were combined and Table 5 gives summation values.

Strain.	Resistance Factors.	Mean Grade.	Plants Counted.
BAR.SP.84	B ₂ B ₃	6.1	839
BAR.NT.205/43	B ₂ B ₃	7.5	833
NT.96/40	Carrying B ₂	9.5	845
P.S.S.	b ₂ b ₃	11.3	836

The local Pump Scheme Strain was badly affected and some of the lower crop was lost. The relatively dry spell in August and September prevented severe loss but heavy rains in October induced secondary infection, the bacterium entering the boll via the peduncle and directly through the carpel wall. This secondary infection caused some lint discoloration but nothing which could be called serious: all resistant strains were severely tested in a season claimed to be one of the worst on record for blackarm attack.

If a sequence of such seasons be experienced with a build-up of blackarm debris in the soil it would appear sound policy to integrate both B₂ and B₃ in the genic make-up of BAR.SP.84. Such a breeding programme has been discussed with Dr. Knight of Shambat who has suggested that B₃ might be introduced from BAR.7/8, a type carrying both B₂ and B₃.

(ii) *Sudan Bollworm* (*Diparopsis Castanea*):— Of the bollworms this genus was the most serious, causing considerable damage to bolls in early November.

(iii) *Leaf Roller* (*Sylepta derogata*):— This pest made its appearance at the end of August and many plants were stripped before control measures could be effected: hand-picking of infected leaves gave a reasonable measure of control.

(iv) *Stainers* (*Dysdercus fasciatus* and *superstitiosus*):—Stainers of both species flighted into the crop in early October; by the end of November their numbers had reached epidemic proportions with a marked preponderance of *D. superstitiosus*. In spite of this vast population, "true" staining was very light and the local crop was one of the cleanest on record.

OTHER CROPS.

(i) *Dura*.

Of the 144 single plant selections on hand, 72 were planted out on July 5th, the residue being held in reserve. Each strain was represented by three single plants and, in order to reduce outcrossing to a

minimum, strain locations were staggered according to maturation period. Throughout the season each strain was regarded in terms of its component single plant progenies, and weak germinators, susceptibles to disease, and offtype lots were discarded. Twelve single plants per strain were eventually selected for the coming season, the residual population to be treated as "commercial stock" for planting out the "commercial bulks" in the 1948-9 season. Such a procedure will be followed from year to year and should conserve the range of types tested and approved for the Nuba area.

Propagation areas at Kadugli of approximately $2\frac{1}{2}$ acres were planted (from June 22nd) to the following approved strains:—

Earlies (i) Tahas 85, (ii) Fanda, (iii) Imsak Maratak. *Mid-Seasons* (i) Birgalli Ahmar (ii) Karinaka (iii) Maga Ahmar. *Lates* (i) Kulum. Droughty and uncertain conditions following planting necessitated much gap-filling and re-sowing and final stands were not good. The yield over all strains on both Kamina and Main Farms was 852 lb. grain per acre against a return of 1229 lb. in the previous season. Dura stem borer (*Sesamia cretica*) took a heavy toll of the crop (80% infection on Kulum) and this, coupled with poor stands, can account for the low yields.

Propagation areas at Talodi of $1\frac{1}{2}$ acres were allotted to the following strains:—*Earlies* (i) Jangi (ii) Kulum Aswad. *Mid-Seasons* (i) Huria White (ii) Kireniga (iii) Kokla. *Lates* (i) Toto (ii) Kulum (iii) Kadeika (iv) Galb El Jackus. As at Kadugli yields were below average, the mean yield over all strains being 642 lb. per acre against 1084 lb. in the previous season.

(ii) *Cow-peas* (*Vigna sinensis*).

Twelve single plant lots (Kadugli 1-12) and three small special bulks covering the range of types required in the Nuba Mountains were planted on July 12th. In the previous season such material had shown marked resistance to an undetermined virus disease and as confirmatory evidence was needed for further selection work all lots were planted out late with surrounding belts of the local susceptible bulk. In early August the latter was showing a severe virus infection of leaf, with mosaic patterning, crimping and in some cases marked suppression of the leaf lamina. Such an infection was recorded in the previous season and was associated with the swarms of white fly living in the plots. All mid-season and late types showed near immunity to the disease but of the "earlies" only Kadugli 4 showed any degree of resistance. This susceptibility of the "earlies," after showing marked resistance in the previous year, is disappointing, for such types are required to bridge the scarcity gap of August-September. The possibility of resistance transfer has not been lost sight of but the attacks from early swarming *Mylabrid* beetles (flower stage) and from *Anoplocnemis curirpes* (pod stage) in which yields are reduced to a minimum might well nullify the benefits derived from any such detailed work. The scarcity of early types in the area and the reluctance of the cultivator to grow them may well find explanation in the early swarming of these two pests.

All resistant types are being bulked up as quickly as possible.

(iii) *Groundnuts.*

In view of the increased importance of oil-producing crops in general world economy and the probability of the expansion of the crop in Kordofan, local and introduced types were tested out in a replicated trial on the Main Farm, Kadugli. The experiment (6 varieties $\times$ 6 replications of individual plot size $1/32$ acres) was planted on July 12th on a site more typical of the northern "Goz" land than of the black cracking clay of the Nuba area.

Excellent stands were obtained and ideal growth conditions prevailed up to the harvesting of the crop. Relevant data are shown in Table 6; oil content figures for the six strains are, unfortunately, not yet available.

TABLE 6.

Strain.	Flowering Com- menced.	Pulled.	Days Mat. Period.	lb. per acre Uncorticated.	Shelling %	lb. per acre Decor- ticated.	100 seeds Wt. Gms.
Barberton ...	7/8	31/10	111	2,384	76.2	1,818	39.3
Medani Runner ...	11/8	5/11	116	2,175	72.2	1,571	58.3
" Erect ...	11/8	5/11	116	2,128	71.5	1,521	57.6
Kadugli Local (C) ...	13/8	10/11	121	2,041	74.5	1,521	50.7
American Erect ...	9/8	4/11	115	2,050	67.5	1,383	75.1
Abu Arba ...	6/8	22/10	102	1,637	71.2	1,166	45.4

Difference required to satisfy 5% pt = 131

" " " 1% pt = 178

The groundnut crop fits in well with a cotton-durâ rotation and the absence of "rosette" disease in the Kordofan area allows of late planting. Apart from the incidence of *Cercospora* leaf spot which has little effect on final yield the crop is remarkably free from diseases and insect pests. It is popular with the native cultivator and its importance in an *organised* rotation should be brought home to him.

(iv) *Sesame.*

In order to study the development of the simsim crop under Nuba Mountain conditions, two adjacent strips of 1 acre each were planted on July 11th to a Red and a White Variety. The latter type is more popular on the heavier soils, the former on the lighter types of "goz" north of Dilling. Excellent stands of both varieties were obtained and the crop made good progress until August 25th, just before the flowering phase. It was then severely attacked by a disease known locally as Marad ed Dam which eventually swept through the Red strain giving 100% infection. This disease which has every symptom of a virus infection differs markedly from the Marad ed Dam disease of the Kosti (Northern) area which, from information received, is the true *Bacterium sesami*. This local infection was marked by a darkening and thickening of the lamina, and a reduction in width with convexing along the midrib: flower buds were suppressed and replaced by vegetative shoots which gave the plant a characteristic "bunchy-top" appearance of fresh green growth: such outgrowths occasionally bore green flowers which were generally sterile. Similar symptoms have been

described from Uganda.* Counts made on the Red strain (October 9th) showed an infection figure of 100%, on the White 43.7%. Final yields per acre of the Red and White strains were 45 lb. and 354 lb. of seed respectively.

Whether the causative organism is transmitted through the seed, soil or by insect vectors it is at present impossible to say : the presence of swarms of *Mylabrid* beetles (spp. *bifasciata* and *bipartita*) and the sesame gall midge (*Asphondylia sesami*) was noted in the crop at flowering time : more detailed investigations of a specialised nature are needed for the elucidation of this problem.

Ninety-eight single plants showing no symptoms of attack were taken from the resistant White strain. In 1948-9 these will be planted in progeny rows over the " Red " area of the present season, one row of the resistant selection alternating with two rows of the highly susceptible " Red " bulk.

Introductions.

On July 12th South African types of soya bean, sunflower and tepary bean (*Phaseolus acutifolius*) were planted in observation plots on the Kamina Farm.

In germination, earliness and final yield per plant the soya bean Barberton Yellow I was far superior to the small-seeded Medani types ECR.279 and ECR.85.

Barberton St. 3 (Sunflower) showed marked vegetative vigour but head size was small relative to height. Compared with the two black types ECR.312 and ECR.314 ex Medani it was very late : thus when the black types were harvested on October 6th and 10th respectively, St. 3 was still vegetatively vigorous and did not yield its crop till one month later.

Tepary bean showed a susceptibility to stem rot and did not seem too happy under the waterlogged conditions of the black clay soil. A " Time of Planting " experiment indicated that plantings from mid August would give the most favourable conditions for the harvesting of the crop.

Seed samples from all lots have been sent to the Inspector, Plant Propagation, Wad Medani.

Acknowledgements.

Thanks are due to the Cotton Experimental Station, Barberton for kindly supplying seed of soya, sunflower and tepary bean : also for cotton seed U.4/5143 $\times$ Cambodia (3 lots) and U.4/8161 $\times$ MU.8 (3 lots) for the 1948-9 season : acknowledgement is made to Mr. J. R. Catford, Inspector of Agriculture, Talodi, who supervised the picking and dispatch to Kadugli of seed cotton for large scale and micro-spinning tests.

* Tothill, J. D. (Editor), Agriculture in Uganda, Oxford University Press, London, 1940.

SUMMARY AND CONCLUSIONS.

(i) Seasonal trends have been followed at Kadugli and relevant meteorological data from both Eastern and Western Jebels have been presented.

(ii) An estimated area of 22,200 acres was planted commercially and this area is expected to yield 8,400,000 lb. of seed cotton.

(iii) Figures from a Compact Family Block Experiment confirmed the homogeneity of all NT.205 material in the breeding plot.

(iv) Yield figures from Main Kadugli and Talodi Varietal Tests have been given : in both trials BAR.SP.84 has significantly outyielded the Control P.S.S.

The closer intra-row spacing (45 cms.) enhanced lint returns per acre by 18.4%.

(v) Blackarm infection figures for four strains are given together with a brief note on insect pests.

(vi) Tested and approved dura strains are listed together with the method adopted for type maintenance.

(vii) Cow-pea selections (*Vigna sinensis*) medium and late varieties, again showed their resistance to an undetermined leaf mosaic. These are being bulked as quickly as possible.

PROGRAMME FOR 1948-49.

COTTON.

- (a) *Breeding*.—Type maintenance and improvement of the following strains :—(i) BAR.SP.84. (ii) Nyasaland. (iii) Wilds 16 (ex Zeidab). (iv) A.2106, A.220, A.292—derivatives from U.4/5143 × Cambodia. (v) A.332, A.449, A.455—derivatives from U.4/8161 × MU.8. (iv) and (v) are introductions from the Cotton Experiment Station, Barberton, South Africa.
- (b) *Testing*.—Four experiments, a varietal and cultural trial and three others to test planting dates, spacing and number of plants per hill. Each of these three trials will be carried out with three different strains.
- (c) *Seed Deterioration* (long-term).—Trials will be carried out to test the progressive deterioration of cotton seed when stored in sacks under Nuba Mountain conditions.

OTHER CROPS.

- Dura*. (a).—Type maintenance of the 24 strains covering the Dilling—Kadugli—Talodi sector.
- (b) Bulk propagation of the most important strains.

Cow-peas.—The rapid multiplication of the eight types (Kadugli 4—11) and the three special bulks resistant to an undetermined disease (virus?).

Groundnuts.—Small scale propagation areas of (i) Barberton, (ii) Medani Erect and (iii) Abu Arba.

Sesame.—Developmental studies on the three strains (i) Red (susceptible) (ii) White (Resistant) (iii) Resistant White with special reference to the incidence of the so-called Marad ed Dam disease.

ZEIDAB.

At Zeidab the Sudan Plantations Syndicate grows two strains of American Long Staple cotton, Wilds No 11 and Wilds Cokers, they are very similar and both originated from direct importations. The lint is fine and lustrous and the staple ranks with some of the longest American (47 thirty seconds of an inch).

The area under cultivation seldom exceeds 5,000 acres and the market is a specialised one. These cottons are known to the trade as " N " cottons.

Two of the major pests met with in Zeidab are Pink bollworm (*Platyedra gossypiella*) and a capsid (*Creontiades*). The Pink bollworm makes its first appearance fairly early in the season but to begin with it is present only in small numbers and as a rule does not greatly damage the first two pickings. However, it later multiplies so rapidly that it completely ruins the final pickings. The capsid generally appears on the cotton in mid-July after the first few bolls have set (it is a sap-sucking insect), the set bolls are not affected by it but it causes abundant shedding of newly formed squares. It is thought that if this strain of cotton could be induced to produce the major portion to its crop two to three weeks earlier, much of it could be picked before these two pests become really formidable. Plants which form their first fruiting branches near the ground are usually early. In other words, a low node number is correlated with earliness.

In Wilds cotton variety grown under Zeidab conditions, first fruiting branches are, on an average, situated at the eight node. A search throughout the commercial crop for plants with sympodia situated in positions below the eight node resulted in the selection of 44 with six or fewer nodes to the first sympodia. The selfed seed from these plants was grown " out-of-season " and produced 44 rows, of which 25 were homozygous for low node number. These will be again tested in season 1948-9 and all homozygotes conforming to the required stands of yield and quality will be bulked and tested against the present commercial crop.

EQUATORIA.

Four varieties were tested, using a replicated strip layout ; each sub-plot measured .06857 acres, and each variety was repeated five times. The varieties under test comprised MU.8B, 511D, and BAR.SP.84 (all seed was procured from locally grown stock). BAR.12/3 (BP.52 carrying the *hirsutum* factor for blackarm resistance B₂) was supplied from Shambat.

The seed arrived towards 19th June and in consequence had to be sown late.

V.T. (MERIDI).

Variety.	MU.8B.	511D.	BAR. S.P.84.	BAR. 12/3.
Yield S.C. per acre lb.	1,370	1,212	1,209	1,174
Yield Lint per acre lb.	447	420	418	364
G.O.T.	32.6%	34.7%	34.6%	31.0%

Difference required for significance = 27 lb. lint per acre.

NOTE.—The G.O.T. (34.7%) is surprisingly high for 511D. Discrepancies between field weights and ginning weights were also extremely high.

[Included by courtesy of the Uganda Government.]

UGANDA.

COTTON EXPERIMENT STATION, KAWANDA,

PROGRESS REPORT FOR THE

SEASON 1947-48.

BY

H. L. MANNING
E. C. G. C. and Acting Senior Botanist.

STAFF.

Mr. Jameson returned from leave in January, 1948. Other staff movements included the arrival of Mr. Thomas and the resignation of Mr. Weatherley. Mr. Kanya visited the Anglo-Egyptian Sudan during the latter part of 1947. Mr. Musisi conducted the work at Serere. Mr. Manning went on leave in April, 1948.

INTRODUCTION AND SUMMARY.

Detailed examination of BP.52 breeding material indicates that selection advances could still be expected, for certain characters, including components of yield.

Gene transference projects including blackarm resistance, seed type and hairiness were carried a stage further.

Summarized yield data for a number of years at Kawanda show that the highest seed cotton yields may be expected from June sowings. This confirms the inference from the most recent sowing date trials.

Two large scale field trials with fertilizers were conducted during the season. In the first, responses to sulphate of ammonia and rock phosphate were not large. However, a stimulus to germination, and also to plant height at 84 days, was recorded for rock phosphate applied before planting. This early stimulus was not reflected in yield, which was uniformly high for the whole experiment. A new type of ridge was tried at Kawanda for the first time. It is possible that this may have contributed to the high yields obtained in this experiment.

The second trial confirmed that the closest spacing led to the highest yield. Also in this trial there was a significant yield response to nitrogen on land newly opened from elephant grass.

Analyses of field observations and yield indicated that a part of the observed relationship between *Lygus* infestation and plant height may be due to an early attraction of the more vigorous plants. Also, the index of leaf damage was shown to be related to final yield.

METEOROLOGY.

Rainfall during the first rainy season was adequate for all crops. Sowings of food crops with the second rains were subjected to dry periods. The most serious of these occurred during the period November, 1947, to February, 1948. Cotton planted on the decline of the main rains yielded well. Late planted cotton and all food crops sown with the badly distributed second rains gave uniformly low yields. The meteorological summary in Table I includes average temperature (mean of max. and min.) and mean daily hours of sunshine. Under overcast conditions at Kawanda the Jordan instrument records as much as two hours less sunshine than the Campbell-Stokes instrument.

TABLE I.
SUMMARY OF METEOROLOGICAL DATA—KAWANDA.

Month.	1947 Rainfall.	1947 Rain Days.	10 Years' Average Rainfall.	9 Years' Mean Average Temperature.	4 Years' Mean Daily Sunshine.	
January	4.40	15	1.86	71.9°F.	5.67	} First Rains.
February	1.96	10	2.51	72.3°F.	5.85	
March	3.57	14	4.17	72.1°F.	6.00	
April	6.69	19	6.09	71.6°F.	5.05	
May	4.77	22	5.76	70.5°F.	4.96	
June	3.53	8	2.39	69.4°F.	4.92	} Second Rains.
July	2.19	12	2.12	68.6°F.	3.31	
August	2.44	8	3.49	69.2°F.	3.70	
September	5.94	13	3.82	70.2°F.	4.60	
October	2.65	9	3.74	71.8°F.	4.89	
November	1.39	9	4.51	71.4°F.	5.05	
December	1.88	10	2.82	71.0°F.	6.18	
Totals	41.41	149	43.28			
Means				70.8°F.	5.02*	

* Mean daily hours of sunshine from a Jordan Recorder.

Rainfall during January, 1948, was 1.29 inches, which fell during 8 days.

GENETICS AND BREEDING.

BP 52.—The purification of existing stocks was the most important phase of this work. The preliminary stages have been outlined in a previous report. During this season small bulks of selfed seed were grown. These bulks consisted of 16 of the 150 originally selected, bulked selfed seed of 5 original lines and 2 commercial selections.

At the time of flowering, plants with very undesirable plant habits were eliminated. Number of days to first flower, with the node number, was recorded for each of the remaining plants. Unselfed seed cotton was reaped by rows to provide estimates of boll number and size.

Selfed seed cotton from each plant was analysed separately for the following characters: mean maximum lint length (Bailey Protractor on three per plant), lint per seed and seed weight.

Variation between plants, and between lines, was higher than would be expected with relatively pure lines. (For mean lint length C.V. = 7.2% ; for lint per seed C.V. = 14.0%). Since these data did not fit an expected normal distribution—there was less than one chance in a thousand that the deviations were due to chance—it was inferred that these BP.52 lines require further sorting. Also it is probable for these characters that selection advances could be expected from plant to row selection.

Uniformity of staple length is considered to be one of the more important breeding aims. High lint per seed also is considered to be desirable. A modal bulk was made at the end of the season and included only those plants within the range plus or minus one standard deviation, for each of the characters lint length and lint per seed. The considerable reduction in the number of plants which fulfilled these conditions left 235 with lint length range 28.7 to 32.3 mms. ; the lint per seed range was 41.0 to 53.0 dgms. Additional selections included 8 single plants which satisfied the conditions of high lint per seed and high lint length. Variable bulks were made from selfed seed of all plants from each of the 23 lines.

BP.52 Multiplications.—The results from the special survey of 1946-47 indicated that several areas urgently required new seed. For the coming season the entire Masaka area is to be replaced with BP.52 seed from the Bale segregated area. This in turn will receive seed from the Kawanda Seed Farm, which receives its seed from the 20 acre increase on the Kawanda Farm. The seed grown on the latter area is B/C 66, which is a 3rd back cross to BP.52 of the blackarm resistant B.181 $\times$ BP.52 hybrid. It is heterozygous for blackarm resistance. Spinning tests, both small scale and large scale, have shown it to compare favourably with commercial BP.52.

Blackarm Resistance.—The importance of resistance to *Xanthomonas malvacearum* has been stressed in previous reports. Transference work involving the B₂ gene was continued during the past season. There are now available for sorting, under the more suitable climatic conditions at Serere, 4th, 5th, 6th, 7th and 8th back crosses to BP.52 of the original B.181 $\times$ BP.52 hybrid.

Seed Type.—Further back-crosses were made on to BP.52 of the naked and tufted types.

Hairiness.—The project to combine the long plant hairs of M.U.8A with the dense hairs of *Gossypium tomentosum* was carried a stage further. Some promising material will be planted out for single plant selection during the coming season.

Verticillium Wilt.—External symptoms of this wilt were observed generally during the season. As before the resistance of B.181 was highest. BP.52 also showed considerable resistance. The BP.50

strains, and many hybrids from Barberton, were highly susceptible. The inoculation technique previously used for this important work is suspect, and further investigational work has been suspended until a more reliable method becomes available.

Variable bulks were maintained of the more important varieties grown in the Protectorate. In addition small multiplication areas were grown of lines of B.181 etc. Seed of the now obsolescent variety Buganda local was reserved for maintenance at the Namulonge Station of the Empire Cotton Growing Corporation.

AGRONOMY.

The yields per acre of the Kawanda Farm are of interest in that they provide some information on effect of time of planting on crop yield. Yields of clean seed cotton per acre with planting months are given in Table II for the seven seasons 1941-42 to 1947-48.

TABLE II.

SUMMARIZED YIELDS PER ACRE OF CLEAN SEED COTTON FROM THE 20-ACRE INCREASE AT KAWANDA FOR THE PAST SEVEN SEASONS.

(Acreages given in parentheses)

Season.	Month of Planting.					Means.
	April.	May.	June.	July.	August.	
1941-42 ...	—	721 (18.0)	770 (1.9)	—	—	726
1942-43 ...	—	968 (6.2)	950 (12.0)	724 (2.0)	—	933
1943-44 ...	—	543 (6.1)	521 (10.9)	371 (3.9)	—	499
1944-45 ...	177 (3.2)	281 (10.7)	798 (5.1)	538 (4.1)	—	426
1945-46 ...	—	—	959 (6.5)	893 (10.7)	712 (3.3)	885
1946-47 ...	—	456 (5.6)	517 (4.4)	491 (7.5)	494 (5.0)	488
1947-48 ...	—	732 (5.2)	675 (0.4)	570 (16.1)	327 (1.9)	588
Means ...	177	611	762	621	533	640
% Stained ...	36.1	11.1	4.9	9.2	10.4	

Average yield/acre clean seed cotton = 640 lb.

Average yield/acre total seed cotton = 712 lb.

The existing agricultural economy necessitates the planting of food crops during the latter part of the first rainy season. The care of these imposes limits of time and effort by the grower, so that the planting of cotton cannot therefore take place until the harvesting period or even later. Table I shows that for the Kawanda Area there is a well marked difference between the two rainy seasons. Planting of cotton could either be carried out during the decline of the main rains—late May or early June—or await the onset of the second rains towards the end of July or early August. Yields per acre derived from relatively large areas over the seven seasons show that the highest total yields have resulted from sowings in May. At the same time it will be observed that the percentage of stained cotton from such sowings is relatively high. This is probably due to the combination of high rainfall at maturity, particularly for the very earliest sowings, and the high level of blackarm, *Lygus* and other diseases and insects. The June sowings, which lead to the highest average yield of clean seed cotton, tend to have less severe *Lygus* infestation. Late sowings, particularly those in August and September, often suffer from inadequate rainfall during the later stages of growth and, with the

protracted growing season expected under these climatic conditions (see Table I), tend to ripen during the onset of the main rains of the following season. There can be little doubt that, for the Kawanda Area, sowings during the latter part of May or early June lead to the highest yield. Subsequent experiments to record picking costs will determine whether the higher yielding but more costly cultivation of May-June is more economic than the lower yielding cotton of later sowings.

Fertilizer Trials.

(1) During the season a fertilizer trial was conducted to investigate further the variety $\times$ fertility interaction observed during the previous season. The experiment, a $3 \times 3 \times 3$ with the three factor interactions completely confounded with blocks, contained three varieties of BP.52—a BP.52 Bulk, BAR.12/3 (a 5th back cross to BP.52 from the Sudan), and B/C 66 (a 3rd back cross to BP.52). The last two strains were resistant to blackarm. Other treatments were three levels of nitrogen as sulphate of ammonia (0, 1 and 2 cwt./acre) and three levels of rock phosphate (0, $2\frac{1}{2}$ and 5cwt./acre). The rock phosphate was applied in holes close to but not in direct contact with the seed at planting towards the end of May. Nitrogen was drilled in about four weeks after planting. Since the land was in the fourth year of cultivation after a four year grass ley, and was sloping, it was considered desirable to plant the cotton on ridges, mainly as an anti-erosion measure.

Plant emergence counts at 14 days indicated that the rock phosphate treatment had stimulated germination. This early stimulus was reflected in plant height at 98 days. The response for one strain—BP.52 bulk—was of the order of 15%. The response of the same strain to nitrogen was only 6%. Counts of early shedding (buds and bolls) showed that nitrogen increased shedding for all strains. The statistical significance of the V. $\times$ P. interaction was due almost entirely to the greater shedding in the BP.52 bulk with added phosphate. Yield levels were high for all varieties though differences could be demonstrated. The varietal response of the varieties to nitrogen differed significantly—that of BP.52 bulk being highest and B/C 66 lowest.

This differential varietal yield response is of considerable value for future breeding plans. It is possible that B/C 66, with slightly higher boll weight, will prove more suitable under low fertility conditions than BP.52 bulk.

It is of further interest to note that this area in the fourth year of cultivation after a grass ley gave the highest seed cotton yields at Kawanda during the past season. Yields during the previous three seasons, when cotton was planted without ridges (i.e. on the flat), were 591, 803 and 622 lb. seed cotton per acre. The average yield of the 0.9 acres of the experimental area was 1,270 lb. per acre. It is possible that ridge cultivation, in a year with poor second rains, contributed to the high yield level.

Yields for the main effects are given in Table III.

TABLE III.
YIELDS OF SEED COTTON IN LB. PER ACRE.

Varieties.	Nitrogen levels.	Rock phosphate levels.
BP. 52 Bulk—1342	0N—1253	0P—1250
BAR. 12/3 —1256	1N—1285	1P—1293
B/C 66 —1213	2N—1272	2P—1269

General mean 1270 lb. p.a.

S.E. for main effects ± 27.3 .

(2) An additional fertilizer trial, also a 3^3 design, but with a split-plot arrangement, was conducted during the season. The three treatments were: time of preparation of land newly opened from elephant grass (*Pennisetum purpureum*); spacing (3 feet $\times$ 1 foot; 3 feet $\times$ 2 feet and 3 feet $\times$ 3 feet), and added sulphate of ammonia (0, 1 and 2 cwt./acre). The cultural operations involved for the first treatment necessitated the adoption of the split-plot design.

One of the main objects of the experiment was to determine the optimum time of *final preparation* of the land after a February ploughing of the elephant grass residue. The 15 week period from ploughing to planting was therefore arranged into three groups: 6 weeks after ploughing with the final preparation 9 weeks before planting; 9 weeks and 6 weeks; 12 weeks and 3 weeks. Elephant grass under a 4 year ley provides a very considerable amount of plant residue. Where cotton is planted too soon after opening, a temporary nitrogen deficiency might therefore be expected.

Germination and early growth were satisfactory. *Lygus* infestation tended to be highest for the closest spacing and the highest level of nitrogen. Only the latter could be considered to be statistically significant. Yield differences were not large though main effects due to spacing and added nitrogen may be taken as real. Seed cotton yields are given in Table IV.

TABLE IV.
YIELDS OF SEED COTTON IN LB. PER ACRE FOR SPLIT-PLOT EXPERIMENT.

Time of preparation.	Spacing.	Nitrogen.
6 and 9 weeks—797	3 ft. by 1 ft.—870	0N—789
9 and 6 weeks—836	3 ft. by 2 ft.—817	1N—829
12 and 3 weeks—821	3 ft. by 3 ft.—768	2N—836
Not significant	S.E. ± 53.2	S.E. ± 15.1

It is of interest to note that yield levels on land newly opened from a grass ley were not high, and also that there was a response to nitrogen after elephant grass. The effect of spacing confirms previous experiments.

Sowing Date Trials.

(1) Kawanda.—Results from the previous season suggested that sowings towards the end of May, or early June, led to the highest yields. In addition there was some evidence that the growing season was protracted under climatic conditions prevailing for the Kawanda area.

During this season a trial was conducted during the period February to June when (normally) less overcast periods may be expected. The design, a simple randomized block arrangement, had 9 sowing dates at intervals of 14 days, from February 19th to June 11th. Unusual rainfall conditions prevailed during January and February (see Table I) and in addition daily hours of sunshine and average temperature were below the expected means. Sowings during March and April, when it was warmer, flowered appreciably earlier than the very latest sowings. Data from sowings after the beginning of May were typical of the results of other seasons. *Lygus* leaf damage counts, plant height, days to first flower and number of potential fruiting points were recorded. Since the incidence of bollworms was high (notably *Argyroproctis* sp.; *Earias* sp., and *Platyedra* sp., in the same relative order of attack) no attempt was made to estimate actual yield.

Data for this trial are summarized in Table V.

TABLE V.
SOWING DATE TRIAL—KAWANDA.

Observation.	Feb. 19.	Mar. 5.	Mar. 19.	Apr. 2.	Apr. 16.	Apr. 30.	May 14.	May 28.	June 11.
Mean days to flower ...	93.0	82.0	83.3	83.0	90.7	89.8	97.8	98.9	100.6
Height at 162 days in cms	101.2	103.7	89.2	85.9	90.0	97.2	92.0	88.0	85.5
<i>Lygus</i> damage ...	2.85	2.05	2.55	3.30	3.45	3.20	1.80	2.80	2.15
Fruiting points ...	78.3	83.0	49.3	36.9	37.7	48.3	37.2	40.5	38.9
Shedding, per cent. ...	83	83	79	83	89	85	79	79	72

The means given in Table V were determined from a large number of plants. Large differences for the following characters, days to first flower, plant height and *Lygus* damage, can be considered real.

Table V supplies additional evidence in support of the view that the growing season is extended during the periods of overcast days. February and March sowings of cotton flower in May before the lowest temperatures. Sowings after the beginning of April experience the relatively low temperatures from June to August. From the practical aspect the reduction was only about two weeks and was not sufficient to avoid the onset of the second rainy season. This would occur during the harvest of the earliest planted cotton. It would appear then that with existing varieties planting on the decline of the main rainy season would lead to the highest yields. However, as the previous trial has shown, this date must be sufficiently early to allow for the lengthy growing season experienced in this area and to ensure reaping during the relatively dry period from December to February. The range of potential *Lygus* damage appears to be at a maximum at the time when grain crops are approaching maturity or are being harvested.

(2) Kabula.—A sowing date trial of the design given in detail in the last report was conducted at Kabula in the south-west of Buganda. Unlike conditions in the remainder of the cotton growing area of this Province, the main rainy season occurs during the second half of the year. There were 10 planting dates at intervals of 14 days from September 13th, 1946, to January 17th, 1947, and at each locality a 2/3rds overlap in time. The altitude of the experimental area was about 5,000 feet. The period from planting to harvest was about nine months for the latter sowings. Yields per acre of seed cotton for the various dates are given in Table VI.

TABLE VI.

SOWING DATE TRIAL—KABULA—SEED COTTON YIELDS IN LB. PER ACRE.

Date.	Sept. 13.	Sept. 27.	Oct. 11.	Oct. 25.	Nov. 8.	Nov. 22.	Dec. 6.	Dec. 20.	Jan. 3.	Jan. 17.
Yield ...	1,281	1,316	1,247	1,058	714	705	568	542	550	490

Table VI shows that maximum yields can be obtained from sowings during the limited period September to October. One of the striking features of this experiment was the pyramidal plant habit of the BP.52 seed stock. Unlike those plants usually observed in Buganda, sowings for September and October produced well shaped plants with a preponderance of lower sympodial bolls. Insect pests and plant diseases were at a low level throughout the ten months' period of the experiment.

GENERAL.

An attempt was made to relate *Lygus* leaf damage counts to final yield. Data from the two fertilizer trials were used for this purpose. A multiple regression analysis was computed for plant height, leaf damage counts and estimates of early shedding, in relation to final yield. Estimates other than yield were based on the means of 20 plants for each of the 108 plots of the first experiment, and the 81 plots of the second experiment. *Lygus* damage counts are measured on an arbitrary scale 0-10. "Early shedding" includes buds and early bolls and was estimated arbitrarily on the basis of scars up to and including the most recent flower. Leaf damage and shedding counts were transformed according to the square root transformation.

Data for the first experiment are shown graphically in Diagram 1.

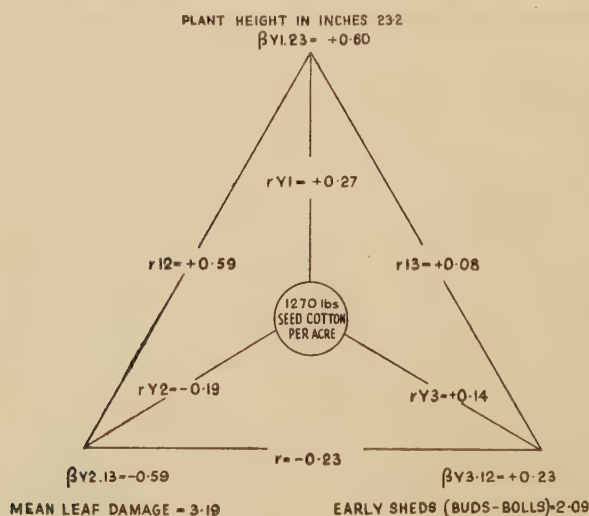


DIAGRAM 1

THE MULTIPLE REGRESSION OF YIELD ON PLANT HEIGHT, CAPSID LEAF DAMAGE AND EARLY SHEDDING. DATA AT 98 DAYS FROM A 3rd TRIAL WITH 3 VARIETIES OF BP. 52 3 LEVELS OF NITROGEN AND 3 LEVELS OF ROCK PHOSPHATE.

Two important inferences may be drawn from these data. Firstly the relationship between leaf damage counts and plant height is confirmed. Plant height at 98 days—before the main flowering flush has been completed—may be taken as an index of vegetative vigour, since the relationship between height and shedding was not close. It would appear then that height preceded the *Lygus* attack in this experiment. The second important

inference is that leaf damage counts can in fact be related to crop losses. The standard partial regression coefficients show that vigorous plants generally yield well ($\beta Y_{1.23} = +0.60$); at the same time these plants appear to be more attractive to *Lygus* ($r_{12} = +0.59$); the relationship between yield and early shedding, though small, was statistically significant, and confirms previous experience. It should be noted that the level of *Lygus* attack was not high (general mean damage 3.19 per plant) and that yield levels were much above the average for the Farm.

Data for the second experiment were examined with multiple regression on yield of plant height, spacing, time of preparation and added nitrogen. One important difference was that field observations were made at 84 days. Since the mean number of days to first flower was 96.8 for late May and early June sown cotton, it may be supposed that early shedding would not be great. The mean node number at which these plants flowered was 7.1. The data are presented graphically in Diagram 2.

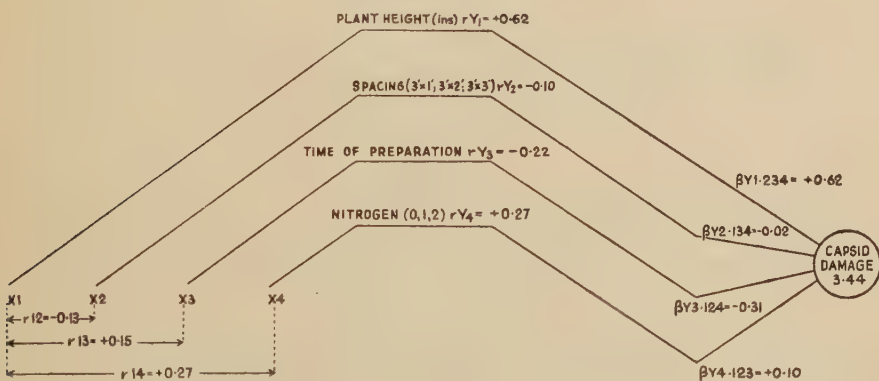


DIAGRAM 2

THE MULTIPLE REGRESSION OF CAPSID LEAF DAMAGE ON PLANT HEIGHT, SPACING, TIME OF PREPARATION AND ADDED INORGANIC NITROGEN. DATA TAKEN AT 84 DAYS, 1947.

Arbitrary values were assigned to spacing and nitrogen in ascending order. For time of preparation the earliest was 9 weeks before planting decreasing to 3 weeks, so that the arbitrary scale was in descending order.

Diagram 2 shows that a close relationship exists between plant height and *Lygus* leaf damage. Much of the effect of nitrogen appears to result from its effect on early growth as measured by plant height.

It is concluded from these sets of data that vegetative vigour is attractive to *Lygus* in the first instance. Confirmatory evidence is provided in the effect due to spacing; that is, the closest spacing

tends to have the tallest plants. The independent effect due to spacing is given by $\beta Y 2.134$ which is only -0.02 . The unexpectedly high beta values for time of preparation may be due partly to height, which was greatest for the earliest preparation.

In conclusion it may be re-affirmed that there is now some evidence that at least a part of the observed relationship between *Lygus* attack and plant height of mature plants may be due to the early attraction of the more vigorous plants. A later effect resulting from bud and boll shedding may also contribute to the main stem elongation. It is of interest to note also that the existing method of estimating leaf damage has shown some relationship with final yield.

ACKNOWLEDGEMENTS.

Investigations in connection with fertilizer trials were made in collaboration with the Senior Chemist, to whom acknowledgement is now made. Field estimates of Capsid damage were made by the Entomological Section through the courtesy of the Senior Entomologist.

TANGANYIKA TERRITORY.

LAKE PROVINCE.

PROGRESS REPORT FOR THE SEASON 1947-48

BY

J. E. PEAT and A. N. PRENTICE.

COTTON, UKIRIGURU.

<i>Planting period.</i>	<i>Picking period.</i>	<i>Legal Uprooting Date.</i>	<i>Rainfall 1st October, 1947—30th September, 1948.</i>	
			<i>Amount.</i>	<i>Distribution.</i>
November—December, 1947, into January, 1948.	May—August, 1948.	7th September, 1948.	27.75"	Difficult in the first half of the season : good in the second half.

INTRODUCTION.

Staff and Development.—Mr. J. E. Peat returned to Ukiriguru in February from leave and study leave. Mr. A. N. Prentice was for the whole season at Ukiriguru : and Mr. J. F. Tregarthen continued as Agricultural Assistant. Mrs. A. N. Prentice has helped with statistical computations.

Mr. H. Doggett, Botanist, Department of Agriculture, has arrived at Ukiriguru and is taking over the food crop work, which has been maintained, of necessity superficially, during the last nine years—work mainly on rice, millets, cassava, and other food crops.

This is the first season that Lubaga has been used for sub-station work only. Mr. J. Colston, Agricultural Assistant, Shinyanga district, devotes part time to Lubaga.

It has been a very good cotton year for the Province as a whole and on Ukiriguru. The Provincial cotton crop is the second largest on record, and cotton on Ukiriguru was outstandingly good. The Ukiriguru building proceeds slowly : the P.W.D. programme for the year was devoted mainly to European and African housing. The great need now is for laboratory, working, and storage accommodation. Other station development and the layout of the new land continue.

There have been discussions through the year on the question of how cotton production could be increased, based largely on the work of Ukiriguru and Lubaga. The Provincial Commissioner, Lake Province, presided over a local committee, and recommendations were submitted to Government. Improved standards of cultivation and production are aimed at in the plans, with increased guidance to and supervision over the cultivators, use of the better seed stocks, and an initial testing of mechanisation.

Visitors.—There has been a large number of visitors throughout the year, including the Parliamentary Under-Secretary of State for the Colonies, Mr. Rees Williams, M.P., and Mr. Proctor, M.P.; members of the Empire Parliamentary Association's Delegation; members of the U.N.O. Trusteeship Committee; members of the Colonial Office Mechanisation Mission and the Rice Mission; the Chief Secretary, the Acting Chief Secretary, the Financial Secretary, the Member for Natural Resources; and the Director of Agriculture and the Headquarters' staff. In addition there have been many other technical and administrative visitors, European and African.

Commercial Cotton Crop.—The Lake Province cotton crop will be between 45,000 and 46,000 bales, the second largest crop on record. For the greater part of the Province production is similar to, or slightly better than, the record production year 1941: the fall away occurs in the South of the Province (Shinyanga district production being around 3,000 bales compared to 9,000 bales in 1941). This relatively good production has not been due to any drive for improved standards of cultivation, nor to the influence of improved seed stocks, which have not yet reached the general cultivator, but to a season fairly satisfactory climatically for the cotton plant, and, probably partly as a result of this, to a low loss from insect pests. There was probably no general improvement in cultivation practices, such as manuring, though the tying of ridges for cotton, a practice which was being pressed, might have had some small effect.

UK.46 being bulked in Uzinza, again under the special care of Mr. von Freeden, Crop Supervisor, produced over 600,000 lb. of seed cotton, a multiplication from 2,300 lb. of seed sent to Uzinza for first multiplication in the 1946-47 season.

3,600 lb. of UK.48 seed has been sent to Uzinza for first multiplication in this coming season.

Weather.—The rainfall for the period 1st October-30th June was 25.90". Planting conditions were difficult: and the period from mid-December until the end of February was droughty and difficult. From March onwards the rainfall distribution was particularly good. Rains extended into early June—about three weeks later than is usual. This, together with the lightness of the jassid, the stainer, and possibly the capsid (*Lygus*) attack, favoured the making of a good top crop.

GENERAL ACCOUNT OF THE WORK OF THE SEASON 1947-48.

HUSBANDRY.

Land Resting.—Four simple trials on the Ukiriguru hill-sands, two established in 1942 and two in 1944, were designed to give preliminary information about resting-crop effects. All four trials had three years under various treatments plus controls of continuous cultivation; two have been cropped subsequently—to grain and cotton alternately—for four years, and two for two years.

As has been reported previously, in all trials, the first indicator crop after grass rest (Elephant Grass in all trials and in addition, in one trial, *Hyparrhenia* and Giant *Cynodon* grasses) was yielding around 40% above the control. In the second year, post-grass yields dropped to the level of the control. There was one exception, where, in one of the older trials, the yield after Elephant Grass kept about 40% above the control for four years. In the other of the older trials, after a re-appearance in the third year (but at a very low level of yield) the benefit from the resting crop had apparently disappeared in the fourth year.

In one trial a pair of variants (continuous cultivation tested against cropping after Elephant Grass) were both manured at 5 tons per acre prior to the first cropping cycle. There was no difference in yield, and both were 60% above the unmanured control; and therefore in this treatment there was no benefit from the Elephant Grass rest. These manured treatments gave successive residual responses of the order of 35%, 85% and 40% average increases over the control in the next three years, on a cotton crop, a very low-yielding millet crop and a cotton crop respectively. In the second year there was again no benefit showing from the rest, but in the third and fourth years there was a suggestion of benefit.

A sound interpretation of some of these results cannot yet be offered. Further results have to be awaited.

With rest under pigeon-pea, the story seems to be an increase of the order of over 40% in the first year after breaking, and of around 15% in the second year. In the one trial which has had pigeon-pea rest-effect followed up for four years (as with the Elephant Grass treatment in this same trial) the pigeon-pea gave benefits up to the fourth cropping year; in this last year the residual benefit was 40%. Results from two other trials next season, designed to measure third year pigeon-pea effects, should help to make clearer what is happening.

Green manuring—one year to velvet beans—gave benefit, on balance, to the first succeeding mixed grain-legume crop: but there was no apparent benefit this second season.

A variant in one trial was rest under cassava for three years. The cassava was allowed to go weedy as in native practice, so the after-effect here may be entangled with "tumbledown fallow"; but at all events the yield response on cropping was a 32% increase the first year, and a smaller but still significant increase of 13% this second year.

Considering the rather late planting, the level of yields this year in these trials was fair, the controls ranging from 550 to 940 lb. per acre seed cotton. All indicator crops happened to be cotton this year, but further trials to be laid down will eventually come out into both cotton and grain every year.

A trial on the black loam soil of Lubaga, now in its third cropping year, had two resting treatments and four treatments under continuous

cultivation: cotton by itself, grain by itself, and the balanced pair of simple rotations, cotton-grain and grain-cotton. The resting treatments, two kinds of grasses, were followed by both cotton and grain every cropping year. The level of yield in both indicators was high this year. The grain (sorghum) still showed a small but significant benefit of 12% from Elephant Grass rest in this the third cropping year, compared with 17% last year; with cotton, the benefit seems to have disappeared this third year, following a 20% benefit last year.

The grass Kavirondo Perennial Sorghum was the other rest-treatment in this trial; it had a very marked depressing effect on grain yields for two years, but this effect has now worn off, the grain yield in the third year being back to the level of the control. With the cotton indicator, yield was the same as that of the relevant control in the first year, slightly better in the second year, and in the third year it is a significant 18% above the control.

It was mentioned in last year's report that another Lubaga resting-crop trial showed substantial gains over continuous cultivation from a range of resting treatments, in the first cropping year. Unfortunately the produce of this trial was badly mixed in the harvesting this year.

At Lubaga simple rotation apparently leads to better yields than does cropping to grain and cotton without rotation. This year, taking no-rotation as 100 for either crop, sorghum rotated annually with cotton was 143 (significant)—compared with 122:100 last year (also significant); and the corresponding rotated cotton was 109 (not significant)—compared with 122:100 last year (also not significant).

A necessary corollary to the resting-crop work has been experiment on the types, establishment and management of possible grasses and legumes. *Chloris gayana*, *Cenchrus ciliaris* and *Bothriochloa insculpta* remain the most promising species of grasses. Ancillary trials have given some information on how to handle these under local conditions. The quest for pasture legumes is still at a very elementary survey stage, and is unlikely to be easily successful.

Manuring.—The different soils continue to give on the whole consistent results from manuring. On the Ukiriguru hill-sands, the length of the residual effect of F.Y.M. or compost is very striking: a dressing of 7 tons per acre applied four seasons ago was this year still showing a 30% increase over the control, on a crop of bulrush millet (control 620 lb. per acre). Another trial, under a moderate crop of cotton (control 790 lb. per acre) was showing an equally big fourth-year response to a 5-ton dressing. The effect of cottonseed ash, 1½ ton per acre, had disappeared in the fourth year.

On the black loam at Lubaga, the direct, first residual, and second residual effect of 5-ton manuring was small and not significant on heavy-cropping sorghum (control 1,940 lb. per acre), and fairly small (16%, 10%, 10%), but significant, on a good cotton crop (control 1,270 lb. per acre). On the red soil at Butulwa, a granite derivative

more akin to the soils of Ukiriguru than to those of Lubaga, a direct 5-ton dressing was giving a 40% increase on sorghum (control 800 lb. per acre).

To recapitulate : on Ukiriguru with the various rests tested there is a definite first year benefit of the order of 40% : there seems to be a smaller second year benefit from Pigeon Pea and weedy Cassava : the second year benefit from the grass rest is more doubtful. What happens in the third and subsequent years is still far from clear. Manuring with a reasonable dressing (5-7 tons an acre F.Y.M. or compost) definitely gives good responses for at least four seasons. At Lubaga on the black loam, direct and residual benefits from rest-cropping have not been large in the main trial, but substantial in the first year in a subsidiary trial. Manuring effects are smaller than on the hill-sands at Ukiriguru. The effect of pure rotation at Lubaga seems to be important.

Fertilizers.—An N.P.K. trial on cotton on the Ukiriguru hill-sands followed one on sorghum the previous year, using the same plots, re-fertilized, so that the residual effect, if any, has been added to the direct effect. The yields were good, from 1,420 lb. per acre seed-cotton upwards. The effect of potash (40 lb. per acre sulphate of potash), alone or in combination, was small and can be ignored. Nitrogen (100 lb. per acre sulphate of ammonia) gave a 7% increase, significant ; and phosphate (silicophosphate, 200 lb. per acre and 400 lb. per acre) gave a 10% increase at both levels, significant. There were no significant interactions, the effect of NP combined being the sum of their separate effects.

Analyses—kindly carried out by the E.A.A.F.R.O. Fertilizer Team—of Ukiriguru-made compost and F.Y.M. show the compost to contain, on an air-dry basis, 0.93% N, and 0.52% P_2O_5 , while the figures for F.Y.M. are 1.5% N, and 0.69% P_2O_5 . Compost and F.Y.M., as has been mentioned in previous reports, give remarkably similar yield-responses. An N-P-K-Compost trial planted to cotton should provide interesting information next year.

The E.A.A.F.R.O. Fertilizer Team has had throughout the year a unit based on Ukiriguru carrying out fertilizer experiments on grain crops.

Agronomy.—Splitting of the ridges is the routine method of preparing land for annual crops on the hill-sand soils such as those of Ukiriguru. The splitting is a laborious operation. An attempt to measure the benefit, made last year, using millet on split and non-split ridges gave inconclusive results, as after a bad start the non-split treatment drew level with the split treatment in final yield. Weeds were troublesome on the non-split ridges. This year, with cotton, on a new site, there was no doubt : the final figures were 595 lb. per acre seed-cotton for non-split ridges against 1,058 lb. per acre for split, 100 : 177. Introducing 5 tons per acre compost shallowly in to the old ridges and the new split ridges gave equivalent seed-cotton yields per acre of 833 lb. for the old ridges non-split compared with 1,350 lb. per acre for the new split ridges, 100 : 162.

At Ukiriguru where 5 ft. ridges are standard, well made ridges are to be compared with "poor" ridges, tied and not tied. At Lubaga the comparison is between flat cultivation and different size of ridges, tied and not tied. This year the results available from Ukiriguru are from good ridges, tied, compared with poor ridges not tied. The good ridges, tied, yielded 14% and 20% better than poor ridges, not tied, for cotton, and 34% for maize. At Lubaga a good-yielding maize trial (control "flat" 2,020 lb. per acre) showed only a 15% benefit from tie-ridging as compared with flat cultivation, a small order of difference for Lubaga, and not significant. But a good-yielding groundnut trial (control "flat" 1,000 lb. per acre unshelled) gave 1,590 lb. per acre in the tie-ridged treatment; in this latter trial the treatment "ridged without tying" gave an intermediate yield of 1,380 lb. per acre. On the hard-pan soil at Lubaga, both cotton and sorghum showed most striking benefits from tie-ridging. "Flat" yielded 950 lb. per acre seed-cotton, the tie-ridged treatment 1,470 lb. per acre, 100 : 154. The sorghum "flat" treatment yielded 1,370 lb. per acre, compared with 2,600 lb. per acre under tie-ridging, 100 : 190. An additional treatment in these trials, testing the 4 ft. against the 3 ft. ridge, both tied, showed a slight non-significant lead to the bigger ridge.

COTTON BREEDING.

The best cotton yields were impressively good. On the manured hill-sands on Ukiriguru the better strains were yielding over 1,600 lb. seed-cotton per acre. By contrast, in the valley bottom, the heavy soil "mbuga," an exceedingly promising crop was caught by a very localised one-generation American bollworm attack, reducing the yield to around half what would have been expected. The American bollworm population was most probably bred up on neighbouring maize—another reminder of the need for care in the planting in the same area of cotton and maize. On the Ukiriguru exhaustion plot—continuous cotton for nine years, with no manure but well ridged and tied—the yield was 700 lb. seed-cotton per acre. The Lubaga exhaustion plot, in its thirteenth year as such, gave 815 lb. per acre. (The Lubaga exhaustion plots gave 1,540 lb. per acre of groundnuts unshelled, and 910 lb. per acre sorghum (Dobbs)).

At Arugongo, in Uzinza, on one of the District Extension Plots on Lake shore sand, yields in a very uniform strain trial were up to 2,400 lb. seed-cotton per acre. Taking the District Plots as a whole—fourteen plots scattered through four districts—the average yield of the better strains in the strain trials was over 1,000 lb. per acre. The price paid to the cultivator this season was 24 cents per lb. seed-cotton Grade A, and 6 cents per lb. Grade C. From such cultivation the return to the grower from cotton was very profitable, even though he was not getting the full price for his crop as Government retained part for the Agricultural Development Fund. The standards of cultivation in general were of course lower than in the District Plots, and some were considerably lower.

UK.46, first issued for multiplication in the 1946-47 season, has a ginning percentage about 1.5% higher than Mz.561 (for example, on standard type sample tests on similar material, 33.7% from the gin opener, compared to 32.2%—excluding loss in gin opener differences). At Ukiriguru in the main trials the increased lint yield over Mz.561 was 7%–13% (the valley bottom main trial distorted by American bollworm attack showed no improvement). Jassid attack this season on Ukiriguru was quite unimportant, and in the main trials blackarm was not severe.

At Lubaga, where there was a fair jassid attack, and bad blackarm, the lint yield increase over Mz.561 was 46%. In the District Plots UK.46 yielded up to 20% better than Mz.561. At Arugongo in Uzinza in the heavy yielding trial there, UK.46 yielded 11% more lint than Mz.561.

UK.46 has good jassid resistance, one of the main reasons for its issue, but it was constituted from strains not studied for blackarm resistance, and on the whole has little if any better blackarm resistance than Mz.561. UK.48 remedies this defect.

An important part of the work of the year has been the sorting out of the material available for, and deciding on the constitution of, UK.48, to follow on UK.46, knowing where the latter and its constituents were displaying weaknesses. The UK.48 now issued for first multiplication is composed of 15% 5/57 and 33% 6/44 (both ex 3/17 ex Mz. "Local"): 19% 6/29 ex 2/388 ex Mz.561: and 33% 6/318 ex 4/35 ex Mz. 561. In the main hill trial at Ukiriguru these strains gave 13% to 26% better yields of lint than Mz.561. In the Lubaga trial they gave mean lint-yield increases of around 75% over Mz.561. In the District Plots the two constituents tested there, 5/57 and 6/44, gave satisfactory lint increases over Mz.561, from around 10% under the easier conditions, up to over 50% where conditions were more difficult.

The ginning percentage of the mixture, judging from the ginning percentages of the constituents, should be slightly better than that of UK.46.

UK.48 should represent a very satisfactory seed issue. When it is the seed stock in general cultivation it should have a considerable effect on production, and, with the increased yields produced, repay many-fold the expenditure incurred in its production and multiplication.

In general, UK.46 and the constituents of UK.48 have much the same spinning qualities and fibre characteristics as Mz.561; spinning reasonably at 40's count, with an Effective Length (32nds in.) of 38–41, and a Standard Fibre Weight per cm. of 185–205. (Shirley Institute Tests.) This year a feature of the lint from the Ukiriguru strain trials sent home to the Shirley Institute has been the high fibre maturity. Good maturity is an important quality in view of the complaints about immaturity and nep in East African cotton. Several strains, possible from the yield standpoint for inclusion in a mixture for issue, were discarded because of poor spinning results.

Continual attention is paid in all selection and testing to jassid resistance. Whatever the other qualities in selected strains, if they are unable to stand up to severe jassid attack under poorish growing conditions they are unsafe.

It is difficult to assess what loss is actually being caused in bad years by *Xanthomonas malvacearum* in its various forms—for simplicity in general reports grouped together as “blackarm.” Under at least fairly good conditions, for example in strain trials, the loss of crop, comparing good yielding susceptibles fairly heavily attacked, with good yielding resistant strains, might be around 20%, more in some instances, less in others. In many crops the loss may be quite unimportant. (In the Lubaga trial, where blackarm loss was severe, L4/112, a good yielding jassid resistant Lubaga strain but susceptible to blackarm, showed 31% improvement in lint yield over Mz.561 compared with a peak of 96% improvement for the best strains in the trial.) Under poor growing conditions blackarm can completely distort young plants, or even kill them off.

At Ukiriguru Knight's grading methods after blackarm spraying have to be modified. With the delayed expression of infection it is not possible to grade on the early development of leaf spots. A collection of strains and selections are sprayed in the usual way and there is thus equal chance of infection: grading for resistance is then made through the life of the plants, with serious attention to the grading made comparatively late in the season. From a more exact grading and sorting of the same material at Shambat (for which we are deeply indebted to Mr. J. B. Hutchinson) there seems to be general agreement in the results being obtained: a grading into susceptibles, and B₂ resistants; and from the Ukiriguru grading the possibility of B₂ enhanced. This latter possibility is being followed up.

It is certainly very desirable, to be safe, to have a reasonably high degree of blackarm resistance in the cotton grown.

The selection and testing work continue, mainly within the partially proved families. It is unlikely now that spectacular improvement will be made like that of the last few years. But consolidation is necessary, and an improvement in certain of the characters desired—jassid resistance, blackarm resistance, a slightly higher ginning percentage, and more uniform spinning qualities, with fibre maturity possibly influencing yarn appearance and a reduction in neppiness.

A collection of strains of other than “Local” origin is maintained, and some are included in strain trials. As a generalisation it may be said that nothing so far introduced and tested yields better than the best of the “Local” stock selections: most are poorer: some are complicated by susceptibility to blackarm. Some have a style of lint different from that which is at present grown in the Lake Province, and some have poorer spinning qualities.

Two non-“ Local ” strains in this season’s trials were A.2106 and M.U.8. A.2106 can show a considerable amount of blackarm damage ; M.U.8 somewhat less. At Ukiriguru, A.2106 was yielding at about the level of Mz.561, with M.U.8 better. At Lubaga, while not up to the better lots, they were similar to UK.46. In the District Plots, on the whole, they were in the same class as the better “ Local ” strains.

In spinning value they are poorer.

PESTS AND DISEASES.

Jassid.—Jassid attack was light this season. Two latin square strain trials were planted with large square plots, instead of the usual long narrow plots, to find if the square plot gave a truer reflection of jassid attack and its effect on yield, but the trials, in their jassid aspect, were rendered ineffective by the absence of jassid. Except in a few areas, jassid did not act as a restraint on cropping this season.

Stainers.—*Dysdercus* spp. were present in the Ukiriguru cotton from April onwards. *D. supersticiosus* in the earlier and *D. nigrofasciatus* in the later part of the season were the common species. *Calidea* stainers were sporadically numerous on the cotton from as early as February to the end of the season. Both kinds of stainers must have found plenty to attract them in the magnificent top-crop of the year, but stainer damage on the stations, and in the districts as a whole, was light to very light.

Percentages of Grade C on Ukiriguru were averaging around 8%, on Lubaga around 14%, and from the District Plots, eleven centres averaged 4%—impressively low—the remaining three averaging 17%. Poisoning by sweetened sodium arsenite was routine on certain parts of Ukiriguru and Lubaga. On Lubaga a late planted and quite unexpectedly well-yielding experiment (control 1,100 lb. per acre) gave 10% Grade C unpoisoned, compared with under 4% poisoned—a very low benefit from poisoning for Lubaga, but also a very low expression of stainer damage.

American bollworm.—Part of the Ukiriguru valley bottom, “ mbuga,” suffered a fierce American bollworm attack in May. This attack, probably bred up on adjacent maize, halved the yields of two strain trials that took the brunt of the attack.

Other insects.—Aphis attack was heavy on the Ukiriguru cotton during the early-season drought, and, although the attack was thrown off as the season advanced into more equable weather, in early March the plants looked very unhappy. Complaints about aphis damage were made from the districts.

On the whole capsid (*Lygus*) damage was probably small. This may have played a part in allowing the setting of the heavy crop, and may be related to the rainfall of the season.

Blackarm.—Blackarm was already appreciable on Ukiriguru by mid-February, before the drought had broken, and was still obvious at the very end of July. The district plots all showed blackarm

symptoms in varying degree, often heavy, and by and large the attack was probably the heaviest yet recorded in the Province. The growing season from March onwards was so excellent that good crops were usually set despite blackarm, but the disease nevertheless might well have been the most serious pest or disease factor limiting yield this season.

At Lubaga, one field suffered badly: this field, and an area in the Uzinza section of Mwanza, were probably the worst seen this season: both had suffered severely from hail.

A modified spraying-grading technique was more successful than last year, and a reasonably even infection was produced in time over the blackarm testing block. Grading for degree of blackarm susceptibility seemed to be good enough for station working purposes. This side of the work will be carried on more intensively next season. Ukiriguru material sorted at Shambat will be grown for blackarm grading comparisons.

Ascochyta blight.—One definite case of blight caused by *Ascochyta gossypii* was confirmed by the Plant Pathologists of the Department, Dr. and Mrs. Wallace. This came from Ukiriguru itself, in April, one of the wetter months. Otherwise, the disease seemed to be quite unimportant this year. There was a tendency in the field to confuse bad blackarm with *Ascochyta* blight.

SUMMARY.

1. It has been a good cotton year, with a production from the Lake Province of between 45,000 and 46,000 bales. The first half of the season was droughty and difficult: the second half had excellent rains, which extended into early June, about three weeks later than usual.
2. The run of cotton yields at Ukiriguru, on parts of Lubaga, and at some of the District Extension Plots was very good.
3. Plans are under consideration for raising the production of cotton from the Lake Province, by improved cultivation methods, and a testing of mechanisation.
4. On the hill-sands, second and fourth year benefits in cropping from rest under elephant grass were mainly nil. Rest under pigeon-pea, and under cassava allowed to go weedy, showed small but significant second-year responses in cropping. On the black loam, the post-grass benefit was small but still present in the third year.
5. Responses from compost and farm-yard manure were as usual big and with a marked residual effect on the Ukiriguru hill-sands and on the not dissimilar soil of the District Plot, Butulwa; and small on the Lubaga black loam.
6. At Ukiriguru in an N.P.K. trial on a heavy yielding cotton crop, the effects of N and P, although comparatively small, were significant.

7. On Ukiriguru the yields from good ridges tied compared with poorer ridges not tied were up to 20% higher for cotton, and more for maize; and tie-ridging as contrasted with flat cultivation led to yield increases varying from small to very large on Lubaga.
 8. The multiplication of UK.46 reached around 200 tons of seed. UK.48 was issued for first multiplication, a mixture of 5/57, 6/29, 6/44, and 6/318. UK.46 showed a general improvement in yield over Mz.561, and the constituents of UK.48 an improvement over UK.46.
 9. Insect damage was light. Blackarm was widespread, and damage was fairly general.
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PROGRAMME FOR 1948-49.

Land Resting.—The original exploratory resting trials at Ukiriguru will be in their fifth and third years of cropping respectively. Two trials are being continued as far as the fifth year of cropping, because of conflicting results in the earlier years of cropping. A resting trial—with grazed fallows, “tumbledown” and planted with local perennial grasses, compared with continuous cropping, manured and unmanured—after three years in the resting phase will be in its first year of cropping to cotton. Another similar trial will be in its second year of rest. A more elaborate resting trial, with the variants coming out in cropping into both cotton and grain, is being established.

At Lubaga the main resting trial has run one six-year cycle and restarts. Two further trials are due to enter their second and third cropping years respectively.

Manuring.—At Ukiriguru residual manuring responses from F.Y.M. and compost continue to be measured. Responses from direct applications will be available from resting and fertilizer trials. An N-P-K-Compost trial ³4 has been laid down with cotton as the indicator crop; and residual responses will be measured from the 1947-48 N-P-K trial, again using cotton.

Agronomy.—The main work in this section is the testing of the value of ridging in various forms, with superimposed on this the value of tying. The ley work, and the observation work on possible grasses and legumes suitable for this, are being continued. A trial, measuring cotton-grain rotational effects, is being established.

Cotton Selection.—This continues along the lines of the past few years; and work will be mainly within selections from the known families. The search for better blackarm resistance will continue: there are possibilities of a further increase in ginning percentage; and fibre maturity and spinning quality segregation in the better families need study. The main cotton yield trials at Ukiriguru and Lubaga are balanced-lattice testing of 49 strains; with two-dimensional lattice testing of 49 strains, with two replications at each centre, at the scatter of fourteen District Extension Plots.

EASTERN PROVINCE.

PROGRESS REPORT FOR THE SEASON 1947.

BY

A. G. BEBBINGTON.

Planting period ...	...	...	...	Mid-February to mid-April.
Picking ...	...	...	...	August to October.
Uprooting ...	...	...	...	By 31st October.

INTRODUCTION.

The report includes the work at Ilonga and on four district plots. Two of the previous plots, at Kingolwira Farm and Kingolwira Village respectively, were abandoned as it was thought that, after five years' records, they had served their purpose in providing information with regard to the behaviour of the cotton plant on that type of soil and also as to the incidence of insect pests.

The site of one other plot had to be changed as the owners required the land. Two further plots in a very fertile area south of the Uluguru mountains were chosen during the year for planting in the season 1948.

The clearing of the large block of one hundred and fifty acres of land at Ilonga was not completed owing to the breakdown of the bulldozer and inability to obtain spare parts. Very large trees had to be removed from the land which would have been very costly to do by hand. A total of one hundred and twenty acres was eventually planted to cotton, maize, cowpeas and beans. The original land on the station was allowed to return to a bush fallow.

Early in the season it was noticed that a considerable amount of sheet erosion was going on although no field was wider than forty yards with an intervening grass strip of four yards width. The average slope of the land is no more than one in seventy. This erosion is owing to the nature of the soil which very quickly packs down to a flat surface under the impact of rain. The land was surveyed and it was decided to put in contour banks, half of which were completed by the end of the year. The Soil Conservation Officer visited the station in December and recommended various other measures which should be taken.

A very considerable amount of time was taken up with development work, mapping, choosing of house sites, and clearing of bush, which is extremely thick. Building was started but progressed very slowly owing to lack of materials.

A short visit was paid to the Rufiji valley in August in order to gain some knowledge of the conditions under which cotton is grown there and, in particular, to attempt to establish the presence or absence of Red bollworm (*Diparopsis castanea*).

WEATHER.

The short rains broke in November but there was not the usual complete cessation of rain this season. Showers continued into June, which is exceptional. Altogether, growing conditions were very good.

AGRICULTURE.

As a result of the good rains heavy yields of all food crops were obtained throughout the Province. A considerable acreage was planted to cotton owing to the rise in price. American bollworm caused quite severe damage to the early crop, but the prolongation of the rains enabled the plants to set a good late crop. Unfortunately, before most of this could be picked, a plague of field mice, on a scale which had not been seen for years, occurred. This destroyed a very large proportion of the open crop and even green bolls were eaten. Poisoning was attempted but the population was so large that it had little effect. There was little damage at Ilonga.

Stainer occurred only in small numbers everywhere and Pink bollworm did not appear until late in the season and then in negligible amount.

The maize crop at Ilonga was planted during January; weather conditions were good, but a serious infestation of millipedes which destroyed the seedlings made it necessary to replant a large acreage. Even after replanting a large amount of damage was caused.

The cotton crop was planted somewhat late owing to the delayed return of the writer from leave. Good weather conditions for germination were present, but again millipedes caused very serious damage. As many as 11-12 millipedes were found in one plant hill. The result was that stands were generally poor throughout. In view of the fact that the millipedes were persistent in the soil it was decided not to replant, as there appears to be no easy method of control.

A fertiliser trial with maize, including treatments with varying amounts of silicophosphate, with and without nitrogen, was laid down. This was a complete failure owing to damage caused by rats and millipedes.

COTTON BREEDING.

The variety trial of four commercial strains tested against M.U.8 A was discontinued. This had been carried out over a period of four years at Ilonga and six district plots. The object of it was to determine whether a productive type like M.U.8 A was capable of giving a better crop than Eastern Province Local, and other types of a similar character, in the face of the insect attack. This point has been proved and in view of that the trials were stopped.

Strain Trial.—Trials of three promising selections from Eastern Province Local, tested against Eastern Province Local and M.U.8 A on three district plots and at Ilonga, were carried out. The results of these were very disappointing.

One trial was completely devastated by bollworm, two others had their yields seriously reduced by rats and the stands at Ilonga were so badly affected by millipedes in the seedling stage as to render the trial valueless.

Single Plants.—The stands were again affected by millipedes in some cases. The final yields were, however, excellent. This is the first year in which it has been possible to obtain combed lint lengths. These are, on the whole, very good. There was a tendency for lint length to be short in some instances in high yielding plants. On the other hand a number of the highest yielding plants had very satisfactory lint lengths, outstanding among these being some selections from the Barberton Sea Island x U.4 crosses. A special bulk has been taken from the selections from Eastern Province Local. A number of reselections were made.

A collection of widely differing varieties sent by Mr. Hutchinson from the Sudan was planted. Amounts of seed were small and millipedes again caused damage. Stands were poor as a result, and this made observations on the behaviour of the varieties difficult. They will be planted again in 1948.

INSECT PESTS.

Continuous records of the principal pests were taken throughout the season at Ilonga and on the four district plots. Plant development records were also taken in conjunction with these.

Jassid (*Empoasca* spp).—No damage of any consequence due to this pest was observed during the season.

American bollworm (*Heliothis armigera*).—This pest occurred in large numbers on most plots, causing serious damage. In one case the population rose to a peak figure of about 6,000 per acre and the attack persisted at a high level for a period of eight weeks. A stainer invasion took place after the bollworm attack ceased, with the result that the crop was totally destroyed. This particular plot is in an area outside Morogoro where large bollworm populations have always been recorded.

At Ilonga all squares on 200 plant hills in two widely separated blocks of Eastern Province Local were tagged. All shed squares and bolls were collected and analysed for damage, as were also the mature bolls. The figures are given in the table below, indicating in the first column, for each block, the actual numbers in each category and in the second the percentage of the total crop set.

	BLOCK I		BLOCK II	
	No.	%	No.	%
Total squares set	8873	—	8317	—
Squares shed due to bollworm	2979	34.4	1161	13.9
Squares shed due to other causes	467	5.4	348	4.1
Bolls shed due to bollworm	3021	34.8	2195	26.3
Bolls shed due to stainer	640	7.3	512	6.1
Bolls shed due to other causes	406	4.6	1637	19.6
Open bolls destroyed total loss due to bollworm	95	1.1	308	3.7
Open bolls total loss due to stainer	42	0.4	137	1.6
Open bolls Grade III cotton	521	3.6	367	4.3
Open bolls Grade I cotton	652	7.5	1412	17.0
Unaccounted for	50	0.6	240	2.9
		99.7		99.5

The figures emphasise two points.—(i) The severity of bollworm damage, almost entirely due to American bollworm. In the first block 70% and in the second block 44% of the total crop set was lost owing to this pest. (ii) The variability in the degree of attack. This may be explained by the fact that the plants in the first block were large owing to poor stands and were probably more attractive than the less well grown plants in the second block. That the plants in the second block were less well grown is indicated by the fact that they lost nearly 20% of their squares due to unknown causes, which probably means that they were unable to keep this crop for physiological reasons. In spite of being less well grown they were still able to bring to maturity more than twice the number of bolls as in the first block and this, on examination of the figures, is found to be very largely due to the difference in the damage inflicted by bollworm.

During the tour of the Rufiji valley at the end of August an attack of American bollworm was seen developing on young maize and cotton planted after the floods had subsided. This would indicate that under conditions such as these, where maize can be planted more or less all the year round, there may be no long term pupal period of *Heliothis* as was previously supposed.

Pink bollworm (*Platyedra gossypiella*).—Very few specimens of this pest were recorded and these very late in the season. As previously mentioned in the report for 1946 this may be due to the extension of the close season instituted in 1945. In a season such as this when, owing to prolonged rains, the plants recovered from the American bollworm attack, and, after uprooting, many clean bolls opened on the plants while they were drying, the reluctance of the farmer and native to uproot can be fully understood.

Spiny bollworm (*Earias* spp).—This was present throughout the season but not in sufficient numbers to cause any serious loss.

Red bollworm (*Diparopsis castanea*).—Intensive search in cultivated cotton at all stages of growth in the Rufiji valley failed to show the presence of this pest. One larva later provisionally identified as Red bollworm by the Entomologist was found on *Gossypioides Kirkii*. This identification remains to be confirmed from moth emergence. *Gossypioides* occurs over large areas immediately behind the coastal plain.

Stainers (*Dysdercus* spp).—The usual four species were recorded, *D. intermedius* again being the most important. Only in two plots in the Morogoro area could they be said to be serious. The crop on all plots was one of the cleanest on record.

Calidea spp.—Very few specimens observed.

Helopeltis spp.—Little damage was caused by this pest.

Capsid (*Lygus* spp).—Few signs of its occurrence were seen.

SUMMARY.

Weather conditions being so favourable the cotton crop of the Province would have been good owing to the recovery of the plants from the early bollworm attack, and the comparative absence of other insect pests, if it had not been for the plague of field mice.

Further progress in the clearing of the main station at Ilonga was made, and a certain amount of building was carried out.

Damage by millipedes at Ilonga and American bollworm and field mice in the district plots rendered the strain trials valueless.

PROGRAMME FOR 1948.

The selection and testing work will be carried on. The routine insect records will be continued.

It is proposed to carry out a comprehensive test of insecticides against bollworm at Ilonga. This will consist of varying treatments with 5% D.D.T. dust and 5% D.D.T. mixed with gammexane applied at various times.

The district plots will be increased to six in number.

Further clearing and surveying of land at Ilonga will be undertaken and an increased building programme has been planned.

NYASALAND. SEASON 1947-48. COTTON EXPERIMENT STATION.

INTRODUCTORY NOTE

BY

H. C. DUCKER.

District.	Elevation.	Types of Crop.	Months in which :		Legal Close Season.
			Sown.	Harvested.	
Lower Shire Chikwawa } Lower River ...	200-500	{ Semi-summer Winter	Jan.-Feb. Mar.-Apr.	July-Oct. Sept.-Oct.	} Nov.-Dec.
Central Areas	1,000-2,500	{ Semi-summer Summer	Jan. Nov.-Dec.	July-Sept. May-Aug.	} Oct.-Nov.
North Nyasa : Karonga Lake shore areas only	1,600	Winter	Mar.-May	Sept.-Dec.	Jan.-Feb.

NOTE.—Close seasons in Nyasaland may be modified in future to accord with the entomological findings, when Government has decided what action to take in the Lower River. The question of extending the close season in the Central Areas to conform with the summer crop technique used at the Domira Bay Station, which is similar to that suggested for the Lower River should winter crop prove impracticable in that area, is also under consideration. Such an extension would mean up-rooting by July 31st, and would provide a close season of four months.

An irrigation engineer appointed by the Nyasaland Government has begun hydrological studies of the Lake and Shire River, and surveys of the Shire valley, in implementation of the recommendations made by Mr. Griffin and Professor Debenham, whose reports, owing to printing difficulties, remain unpublished. The studies and surveys are expected to take three years, but a preliminary report on the Lower River Shire possibilities may be available within two years.

A conference between members of the Nyasaland Agricultural Department and the Portuguese Authorities was held at Chiromo in early August, 1948, and it is expected that the small-scale experiment of summer cropping in the Lower River, proposals for which were reported last year, will be carried out under the joint supervision of the two Governments. The area, of five miles radius, will be centred on Makanga Experiment Station, near the Ruo/Shire confluence at Chiromo, and adjacent to the international border. It will lie, therefore, partly in each of the two territories.

The inherent agricultural circumstances of Nyasaland remain unchanged, but a season of fairly good rains is enabling the Lower River to produce a large crop. It appears that two successive years of late planting, reinforced by the very early rains of 1946/47, have resulted in a marked diminution of the pest population of the Lower River, the good effects of which are being felt this season, especially to the west of the Shire. On the eastern side, however, there is more bollworm this year than last, and as early as July some severe damage was being reported. Since the 1947/48 crop was planted somewhat earlier than that of the previous two years, all is unfortunately set for a further rise in the pest population. This is only likely to be obviated if very early rains in 1948/49 cause premature emergence of many long term pupae, and are followed by another year of late planting.

High prices for tobacco and food crops, and an ever-intensifying demand for export labour to the Rhodesias and South Africa, have off-set in large measure the improved price factor in the Central Areas and impeded the hoped-for development, but North Nyasa continues to prosper with its small, but highly successful winter crop in spite of transport, and other difficulties. The tragic loss of the M.V. "Vipya" is still being felt, but it is hoped that a tug and barge service may improve matters before long, both at Karonga and along the Lake littoral of the Central Areas.

Transport to and from Nyasaland generally has been gravely hampered by the loss of the Chiromo Rail-bridge, which collapsed towards the end of last rains. This contingency has been threatening ever since the Lake rose and the Shire River began to run full-bore.

The Railway Authorities have put an emergency rail-ferry service into operation, but the Chiromo crossing will continue to be a bottle-neck till a new bridge can be built. It seems probable that this will not be accomplished before 1950/51 at earliest.

Supply difficulties owing to the break in the rail link are being emphasised by the world situation. Great difficulty is being felt in marketing cotton and other crops owing to shortage of gunny bags and hessian, and the ginneries are having a particularly trying time.

The Experiment Station has had rather a good year with timely and, on the whole, well distributed rains. There has been a pleasing absence of damaging storms and high winds.

Labour shortages have, however, impeded work and food crops had to be sacrificed to cotton. Had it been possible to give all crops adequate attention yields generally would have been good.

Government has decided to develop the Chitala Reserved Area, adjacent to the Cotton Experiment Station, as a Group Farming Settlement Scheme, whereon cotton seed multiplication will be one of many activities. This scheme replaces the individual holding scheme, inaugurated in 1938 on these lands, which has been adjudged a failure in so far as progressive agriculture is concerned, though the tenant smallholders themselves have led a smugly satisfied existence on or perhaps a little above the usual subsistence level common to much of Nyasaland.

It is hoped by the aid of tractors and implements to develop a higher standard of farming than that of the native axe and hoe, and to increase not only food supplies, but also cash crops in this area. Soil conservation and the maintenance and, if possible, improvement of fertility will be points to which special attention is paid.

These machines will also be available for the use of the cotton station, and the Corporation staff have agreed to look after them. A member of the Nyasaland Department of Agriculture, who is living in one of the Experiment Station houses, will take charge of the Group Farming Scheme, which it is hoped will begin in 1948/49.

It seems probable that this scheme will take at least four or five years to establish properly, even if the tenants give their fullest co-operation, since there is a lot of work to be done in preparation for it, clearing, stumping, levelling termitaria and the like.

The general cropping plan is one of contour strip cultivation, with rotational cropping on lines which the work of the Experiment Station has shown to be sound, and with adequate resting periods under grass leys or similar cover. Individual gardens for each tenant will probably have to be allocated annually.

Mr. S. T. Hoyle transferred to the Nyasaland Department of Agriculture at the end of his leave last year, and is now developing a new Agricultural Research Station near Lilongwe, some sixty miles from Domira Bay. This Station, at an elevation of about 3,700 feet above sea level, will be in large measure complementary to the Cotton Experiment Station at 1,980 feet, and some useful co-operative work is confidently expected. Some seed stocks have already been supplied to Mr. Hoyle and other help given: he on his part has helped the writer with 1948 statistical analyses, help which is gratefully acknowledged.

Mr. W. L. Miller had the misfortune to be taken ill in October, 1947, and was unable to undertake field work up to his departure on leave in February, 1948. It is good to be able to report that he has now been restored to full health and is returning to the Station in October, 1948.

Mr. M. S. Hastie has been appointed as successor to Mr. Hoyle and is also due to arrive in October, 1948.

DOMIRA BAY STATION. PROGRESS REPORT, 1947-48.

BY
H. C. DUCKER.

GENERAL SURVEY OF THE SEASON AND OF THE EXPERIMENTAL WORK ;
AND CONCLUSIONS.

METEOROLOGY.

The total rainfall for the season, November, 1947, to May, 1948 inclusive, was 34.59 inches, only a little in excess of the eighteen year average of 33.77 inches. The rains broke at the beginning of December and apart from a few dull spells of drizzling rain were well distributed. There was a remarkable absence of heavy storms on the station, and only twice during the rains was a fall heavy enough to make drains run. For the second year in succession the dams have not overflowed, replenishment of ground water supplies has again been good, and the level of water in the bore-holes is higher than ever before.

In addition to the usual rainfall, temperature and humidity records, full sunshine records have been kept this season. It will be very interesting to see how these compare with others in years to come.

AGRICULTURE.

General.—Food crop planting began on December 1st, 1947, and was completed by the 10th. A short interval in the rains with hot sun enabled cotton fields to be given a pre-planting cleaning, always a good practice, and the whole cotton acreage was sown between December 17th and 24th.

This was an excellent start to what should have been a good all-round season, but poor turn-outs of labour and persistent absenteeism caused the work of cleaning the food crop acreage to lag sadly, and only those plots which received adequate inter-cultivation gave good returns.

Much of the labour difficulty was undoubtedly due to the partial famine which this part of Nyasaland has experienced during the past year, but there is a greatly increased amount of sickness to report compared with previous years, and at least some of the trouble was due to dissatisfaction with the conditions of employment. The abandonment of the method of paying field labour by the calendar month, where amounts received varied with the number of days worked, and a return to the old system of paying on a completed work ticket of 27 days, seems to have improved matters a great deal. But it is too early to know whether this is a complete answer, since labour is always relatively plentiful during the dry season. As in most parts of the world wages have increased considerably over pre-war rates, but it cannot be said that there has been any improvement in the amount of work done. A system of attendance bonuses, tried out on a small scale last rains, seems likely to be popular, and may help the work this coming season.

The bulk of the available labour was concentrated on the cotton fields, devoted mainly to the plant breeding programme as in 1946/47. On an acreage reduced to $51\frac{1}{2}$ acres, yields were good by Nyasaland standards, averaging about 750 lb. seed cotton per acre with the better material, approximately 240–250 lb. lint per acre.

Maintenance of Fertility.—The long term experiments described previously are now well begun, but certain difficulties are becoming evident.

When maize and rest crops are mixed together as plots in a randomised block layout, there is ample cover from view. Thieves, animal and human, find the maize attractive, and protection from them is not an easy matter. It seems probable that only in the test years when all plots are sown to a single crop, will yield figures be reliable. Fencing the Station would be a possible answer, but a very expensive one in present circumstances.

Grasshopper, particularly *Zonocerus elegans*, attack is also severe where resting and cropped plots are intermingled, and this also is difficult, if not impossible, to control with our present facilities.

Another difficulty with rest-cropping experiments is the fire hazard, which has been forcibly brought to our notice this year by the burning of most of our rest crop areas by some person unknown.

Burning of dry vegetation in garden lands and in the bush is a favourite practice with the local Achewa natives, since it enables them to indulge in the sport of rat-hunting, rats being a popular form of food. It is almost impossible to stop the practice in the present state of education of the African, and in any case there is a sound reason for burning under certain conditions; to destroy cover for carnivora—there is a man-eating leopard in the district at present—and to prevent the accumulation of dangerous masses of inflammable material near villages and other built-up areas.

The fire this year, started on a day of high wind, jumped every fire break on the station fields, and, as one consequence, no comparison will be possible between burned and un-burned plots in the two latin square rest cropping experiments begun last year. It seems possible, since natives' gardens will inevitably be burned over annually for years to come, that such comparisons are not worth while.

Before the firing occurred, vegetation analyses had been made in these plots, on a rough basis of species estimates. It is hoped in due course to obtain identifications of all the weeds and grasses involved.

The long term experiment begun in 1942/43, wherein 3, 4 and 5 year rest periods are being compared, has been cleared and brought back into cultivation for test-cropping in 1948/49 with maize. It is intended to sample all plots in this experiment for soil crumb structure analyses, before next rains begin.

What appears to be a steady increase in the Itch or Buffalo Bean population of our fields has a bearing on rest-cropping and the time for clearing land which has been rested. This bean, the wild form of velvet bean (*Stixolobium. sp.*), starts to ripen its pods in March and thereafter can be handled with any degree of comfort only under wet conditions. This is an added argument for power cultivation, which will enable clearing to be done during the rains at a time which would be impossible with hand labour only at our disposal. It must, however, be admitted that Itch Bean is very probably the source of some of the fertility of this station.

Mixed Cropping.—The 1946/47 experiments were repeated on new sites and carried through successfully. Randomised block layouts were used. In the experiment comparing differing intra-row spacings of maize, the treatments were as follows:—

	1.	One row maize with 3 plants per hole	× 1 foot	...	...	...	Three rows Cotton
	2.	" " " "	4 " "	× 2 "	...	...	" " "
	3.	" " " "	5 " "	× 3 "	...	...	" " "
I.	4.	All maize	" 3 " "	× 3 "	...	...	" "

The experiments comparing different cotton densities had the following treatments :—

II.	1.	One row maize	...	...	...	...	Two rows cotton	Maize spaced 4 plants $\times$ 2 feet as in 2 in Experiment I.
	2.	One row maize	...	...	...	...	Three rows cotton	
	3.	One row maize	...	...	...	...	Four rows cotton	
	4.						All cotton	

Cotton was spaced three plants per hole by 2 feet intra-row in all cases and a standard inter-row spacing of 3 feet was used throughout.

The station bulk of local maize was used, and planting was done on December 6th. C.L. 20-20 cotton was planted in the cotton rows a fortnight later, after the maize had received its first cleaning. This is approximately what one would hope native growers who adopt mixed-cropping would do.

Treatment 2 was the same in both experiments and served as a control. Results are summarised in the following table :—

		YIELDS PER ACRE			GRAIN/SEED COTTON.		
		Maize.			Cotton.		
		lb.	Control = 100%	Pure stand = 100%	lb.	Control = 100%	Pure stand = 100%
I.	1.	693	102	61	343	104	—
	2.	682	100	60	330	100	—
	3.	649	95	57	366	111	—
	4.	1144	168	100	—	—	—
II.	1.	704	119	—	173	69	35
	2.	594	100	—	248	100	51
	3.	510	86	—	312	126	65
	4.	—	—	—	484	195	100

Differences between 1, 2 and 3 are highly significant for cotton in experiment II, but fail to reach significance for maize, due, it is believed, largely to theft of cobs by baboons.

In experiment I a quarter stand of maize is giving more than half a pure stand crop. A three quarter stand of cotton is giving just over half a crop reckoned on the same basis. This season varying the maize density within the row did not affect yield. In experiment II a two-third stand of cotton gives only 35 per cent. of a pure stand yield, three-quarters gives 51 per cent. and four-fifths gives 65 per cent. One third maize gives 71 per cent.; one quarter 60 per cent.; and one fifth 57 per cent. of the pure stand yield in each case.

The maize in both experiments gains heavily from the wide spacings and in all cases cotton suffers from mixed-cropping even at the widest spacings of maize.

It is obvious from these figures that if mixed-cropping must be done the percentage of maize must be kept as low as possible, and should not exceed 20 per cent. of the stand if cotton is to give a reasonable yield, under true summer crop conditions. It must be remembered too that these experiments were given reasonably good cultivation and that the timing of planting was controlled. In native gardens, weeding will not be so well done and there will be a mixture of times of planting. Cotton is likely to suffer more in such gardens.

A comparison between these two experiments is not too satisfactory since they were separate, though in neighbouring and similar fields. A further experiment making a direct comparison between pure stand maize, pure stand cotton, and mixtures of 25 per cent. maize—75 per cent. cotton, 20 per cent. maize—80 per cent. cotton is being planned.

ROTATION CROPS.

Maize.—This crop was planted under good conditions at a more normal time than in 1946/47. Good stands were obtained and early growth was satisfactory, but poor labour supplies made it necessary to neglect all but the more important experimental plantings, and the average yield was only about four bags per acre from 72 acres. Owing to the partial famine, thieving of green cobs was rife in spite of all that could be done in the way of watchmen. Yields from plots which received adequate cultivation, and which escaped the thieves, were as high as $10\frac{1}{2}$ bags per acre, and the poor bulk return cannot be attributed to climate or soil.

The $2 \times 2 \times 2$ factorial experiment with continuous maize which has now been running for several years at the station and on various district plots was repeated, and the only significant result obtained was from the treatment wherein weeds were buried and ridges heaped up early in the rainy season. No other factor was of interest and it seems certain that efficient weed control is essential for high yields, other factors being equal. The application of this to power cultivation is obvious, since a row-track tractor with ridging bodies will do much to break the labour bottle-neck which exist in December/January.

Treatments and results are summarised below :—

Layout. Randomised blocks with abc confounded in sub-blocks.	
A. Light hoeing with weeds left on surface.	W. Ridges heaped up and weeds buried in intercultivation.
B. Maize trash buried when making up ridges in preparatory cultivation.	X. Maize trash burned and ash buried in preparatory cultivation.
C. 3' inter-row $\times$ 4' 6"	Y. 4' 6" inter-row $\times$ 3'

Lb. Grain per acre.			
WXY	1695	AXY	685
WBY	1695	ABY	683
WXC	1593	AXC	815
WBC	1455	ABC	778

Sig. Diff. 58. lb. (P = 0.5)

In an experiment comparing three ways of clearing land which had completed its resting period under elephant grass, striking increases in maize yield were obtained from plots, cleared during the latter part of the rains, on which the grass was buried in large ridges. Whatever may have been the cause, manurial or cultural, it is evident that here too the application of power cultivation to work impossible on any scale with hand labour only, will result in immediate increases in the yield of our major food crop. The practice of clearing and burying debris during the rains is known to the natives of this

district as "Maoza" and its good effects are well understood. The figures are so striking that they, and the treatments, are given below:—

	Grain lb. per acre.
1. Normal Station practice. Elephant grass cleared and trash burned <i>in situ</i> . Land dug in April, ridged at normal time in dry season.	688
2. Stubble mulching. Elephant grass cut and carried off to simulate grazing. Land dug as above and ridged likewise.	490
3. Grass cut and buried in large ridges which were broken down when the plots were ridged ...	2,160
Sig. Diff. 175 lb. (P = 0.05)	

Groundnuts.—Much the same fate was suffered by this crop as befell the maize, but where it was grown on red soil previously planted to cotton and so left relatively clean, fair yields were obtained. Black soil areas again gave poor results, largely owing to water-logging. It is hoped that some power cultivation will enable bolder ridges to be made and a deeper tilth, which should improve surface drainage.

Sorghum.—Some twenty acres were planted with the local giant grain sorghum which proved to be far less susceptible to neglect than maize. In spite of minimum attention and a certain amount of theft, yields of grain averaged nearly $\frac{1}{2}$ ton per acre.

As suggested in a previous report, sorghum merits more attention as a food crop, and it forms an admirable precursor to a grass resting ley when treated in native style as a perennial.

The fields have been burned over after the harvest as in native practice, and the stools are showing good regrowth.

The importation of grain types of sorghum of varied habit and with good keeping qualities is likely to be worth while.

TANKS AND DAMS.

The experimental series is now completed and, apart from minor up-keep work and constant discouragement of would-be rat hunters who delight to dig holes in the banks, will need little further attention. For the second year in succession no dam has over-flowed, and the accretion to the local ground water supplies due to the absorption of all the rainfall which would otherwise have flowed out to the lake must have an excellent long term effect on the bore-hole supplies. The conversion of the main station acreage into a closed drainage system is providing opportunities for observations of soil movement as well as of water supplies. So far there is little evidence of any serious erosion taking place, and such accumulations of silt as exist can be accounted for by wash within the excavated areas of the dams. This wash ceases as soon as they contain sufficient water to cover the excavations.

The tank-dam, where previously the ground water level stood at least 60' below the surface, provided a steady supply of water at 11' all through last dry season, and looks like doing the same this year. The water from it is preferred to the bore-hole water by many of the labour since it is far less saline than the latter.

Supervision of the construction of a large dam on Trust Land, near the N.W. boundary of the Station, has been undertaken on behalf of the District Administration. This dam, with a catchment three to four times that of the biggest experimental dam, is nearly completed and will be filled, it is hoped, next rains. If successful, it will make possible the settlement of some good agricultural land at present unoccupied owing to its distance from domestic water supplies, and enable the worst Tsetse fly focus in the immediate area to be cleared.

SOIL STRUCTURE STUDIES.

Owing to shortage of staff, work on this interesting subject had to be suspended this season. But it is hoped to continue with it in 1949 or even later during the present year.

MISCELLANEOUS WORK.

At the request of the Department of Agriculture, nine samples of cotton seed from the Soviet Union were planted in small observation plots.

Two lots failed to germinate, their seed being apparently dead, since it just rotted in the ground. Only two of the remainder germinated well, the rest being rather patchy.

Of the seven lots producing plants, five were hopelessly susceptible to jassid and only produced shrivelled little bushes. The other two grew moderately well but proved to be rabid shedders, and hardly a flower produced a sound ripe boll.

All the plants which grew at all were of markedly sympodial habit and had presumably been selected for extreme earliness.

Last year a collection of local grass seeds were made, and these were broadcast in small observation plots last January. The plots have been burned over and the regrowth studied. Only two grasses, a species of *Hyparrhenia* and a species of *Brachiaria*, have left any progeny, and the stand of the former is decidedly the better. Since this is a good thatching grass some further work on establishing local-grass leys by seed seems worthwhile.

COTTON BREEDING.

The cotton acreage was again utilised for large scale breeding work, and 576 progeny rows arranged in family groups, and about 70 small and large bulks, were planted.

The breeding work was centred on three balanced lattice square experiments, using $\frac{1}{2}(p+1)$ replications in each case. These together covered the entire range of our material, and comparisons were essentially on the basis of yielding power, following the search for good spinning quality made last year with the help of the British Cotton Industry Research Association.

The main experiment was a 7×7 lattice square arrangement in which 48 selections, from Crown Land commercial bulk via C.L.20, selected in 1946 and submitted to spinning test last year, were compared with the best commercial bulk obtainable from the Chiromo ginnery of the British Cotton Growing Association. The help of the Manager in Nyasaland of this Association is gratefully acknowledged, the seed supplied being vouched for by him.

The yield and quality (1947) statistics of the leading strains and control are given in the following table :—

Strain Number.	Yield in lb. per acre.		Yield Seed Cotton as % Control.	Corrected Count $\times$ strength product at 40s counts.
	Seed Cotton.	Lint.		
C.L. 6019	1016	340	149	2308
" 6086	962	320	141	2214
" 6161	954	308	139	2418
" 6046	948	316	139	2186
" 6055	936	315	137	2132
" 6177	924	305	135	2054
" 6054	917	304	134	2258
" 6069	905	300	132	2203
" 6083	890	300	130	2224
" 6068	881	282	129	2348
" 6135	867	288	127	2372
" 6057	858	292	125	2189
" 6079	848	275	124	2431
" 6122	792	267	116	2493
" 6026	789	264	115	2118
Control C.L.B. Chiromo	684	220	100	1850 approx.
Significant Diff. $P=0.05$	169	—	25	—

No fewer than fifteen of the C.L.20 sub-strains gave significantly higher yields than the control, and of them twelve have been retained for further study in the form of large bulks, progeny row bulks and further single plant selections. There are about 1,000 of the latter. The three lots not retained were from C.L.20.34, the lint from which is generally of a lower quality than the other C.L.20's.

Three sub-strains which did not exceed control by a significant margin were also retained and their statistics are given in the foregoing table. Two were kept on the basis of spinning quality and the third because it did rather well on the first picking and may be particularly early.

If, as is hoped, the good performance of these sub-strains is confirmed next year in Station and District trials, a valuable range of material will have been obtained for multiplication and distribution in place of the present Crown Land commercial bulk.

The second trial was a 5×5 lattice experiment for a general comparison of varieties, and in particular of local crosses in F_2 . It contained controls common to the other two experiments.

Only the local crosses, N.A. (B.181 $\times$ T.22) and N.D. (B.181 $\times$ C.L.20—46), M.U.8B from Indore, and H.K.2(U.4 $\times$ Cambodia $\times$ U.4 from Dr. Harland) gave returns comparable with the leading C.L.B. selections, and none exceeded the best of the latter in yield.

The third lattice square layout was another 5×5 comparing the sub-strains of T.22 (ex Mz.561) with two of their parent strains. Though yields were good in this experiment not one of the sub-strains out-yielded the parent controls and the latter in their turn did not beat Commercial C.L.B. in the second trial.

In view of previous failures on the part of the Mz.561 derivatives, both at the Station and in District trials, it has been decided to abandon work on this family, for the time being at any rate, in spite of the excellent lint quality, with good maturity, shown by some of the sub-strains.

Though H.K.2 is still a good yielder, and with its high ginning out-turn is probably the best producer of lint we have, its quality is unpleasing and its yarn strength low on African standards. In terms of seed cotton, and the Nyasaland crop is bought and sold on this basis, it is now only one of a crowd of good croppers; whereas in a trial in 1942 when it was last tested on a field scale, it was outstandingly our heaviest yielder.

There seems little point in doing much work on short staple cottons like M.U.8 since this too is no better than many other cottons of longer staple when measured in terms of seed cotton.

A range of material from the second and third trials, as well as from the C.L. selections listed above, has been sent to the B.C.I.R.A. (Shirley Institute) for full scale trial, and on the results will depend what further work is done on the leading varieties and crosses. Yield figures are given below for some of the second trial material.

Variety or Cross.	Yield of Seed Cotton.		Yield of Lint. lb. p.a.
	lb. p.a.	% Crown Land Bulk.	
N.A. (B.181 $\times$ T.22)	906	130	285
N.D. (B.181 $\times$ C.L. 20—46)	893	128	295
M.U. 8B	887	127	290
H.K.2	859	123	330
N.B. (B181 $\times$ C.L.20—20)	837	120	266
A.2208	833	119	273
N.C. (B181 $\times$ C.L. 20—34)	815	117	273
C.L. 20—20 Bulk	790	114	266
U.B. 6019 ex B.181	728	104	236
Crown Land Bulk Control	698	100	228
T.22—20 Control	768	110	235
Significant Diff. $P = 0.05$	151	22	—

Work on crosses N.A. and N.D. is obviously justified and they should combine a large number of valuable characters. N.B. and N.C. are also worthy of further attention.

Yield figures for material sent to the Shirley Institute from the third experiment are given below :—

Variety or Strain.	Yield of Seed Cotton.		Yield of Lint. lb. p.a.
	lb. p.a.	% Crown Land Bulk.	
T.T. 621	920	114	274
T.T. 698	910	113	299
T.T. 22—20 Control	886	110	290
T.T. 669	883	110	272
" 669	848	105	278
" 620	812	101	272
" 688	807	100	263
" 623	790	98	247
" 618	775	96	238
Significant Diff. $P = 0.05$	128	16	—

Selfed and natural bulks have been kept of all varieties grown this year in the miscellaneous collection, but in view of their performance no single-plant selections have been retained from the T.22 ex Mz.561 family. The large and small bulks and progeny row bulks of this family are however being stored.

PESTS AND DISEASES.

Insect Pests.—The usual flower taggings were done, on a bulk of T.22—10 cotton conveniently situated in relation to the cotton acreages of last year and this year, and thought to be reasonably representative. Results are summarised below :—

	Number	%
Total Flowers tagged	3595	100
Losses due to bollworm	480	13.4
Losses not due to bollworm	1967	54.7
Total ripe bolls	1091	30.3
Taggings lost	57	1.6
Totals	3595	100

The infestation was mainly red bollworm (*D. castanea*) as is usual, and was about the intensity to be expected with a normal carry-over and the reduced acreage of cotton this year as compared with last. It is hoped that power cultivation may do something to reduce the carry-over of red bollworm, possibly by encouraging long term pupæ to emerge prematurely, or even by crushing them mechanically. No further work has been done with insecticides in attempts to control red bollworms directly.

Stainers were in evidence as usual at picking time, but also as usual their invasion of the crop was too late for much damage to be done by them.

Jassid attack was severe on certain susceptible cottons, but the bulk of our collection carries enough resistance to make this pest a negligible matter. B/C.66 from Uganda and U.B.6191 ex B.181 suffered quite badly, as did the two SP.84 derivatives, BAR 7/1 and SUS 7/2, from the Sudan. M.U.8B was outstandingly resistant to this pest.

Blackarm.—This disease, or rather, what we have been calling blackarm, was in evidence on several cottons especially C.L.20—46 and various other C.L.20 derivatives which have been discarded as low yielders. But the behaviour of the four varieties from the Sudan, kindly supplied by Dr. Knight, did not suggest that it is a limiting factor here. Their yields in the second variety trial were as under :—

	Yield of Seed Cotton.	
	lb. p.a.	% Crown Land Bulk.
Sudan BAR 7/1 ...	693	99
Sudan SUS 12/2 ...	662	95
Sudan BAR 12/1 ...	622	89
Sudan SUS 7/2 ...	571	82
C.L.B. Chiromo Control	698	100
Significant Diff. P = 0.05	151	22

While it seems certain that *X. malvacearum* is present in Nyasaland, it does not appear to be a limiting factor in all cases, and it would appear that our main varieties carry a considerable degree of resistance. The T.22 range have been shown by R. L. Knight at Shambat to be homozygous for B₂ resistance factor.

There are, however, exceptional attacks of what looks very like blackarm even on varieties which like our C.L.20—46, are known to contain B₂, and the question arises of whether we are really dealing with *X. malvacearum* in all cases.

The attack of *Ascochyta gossypii* reported from Lubaga by A. N. Prentice has caused us to wonder whether this disease may be present at Domira Bay.

A pathologist is being appointed to the new Lilongwe station, and it is hoped to enlist his help in studying this problem. In the meantime the pycnidia described by M. M. Wallace (E. African Agricultural Journal, July, 1948) have not been observed.

SUMMARY OF MAIN CONCLUSIONS.

1. A good season, of which it was impossible to take full advantage owing to labour shortages, was experienced. Yields generally were good where inter-cultivation and weeding were adequate, but neglected maize gave poor returns, and ground nuts likewise. Sorghum was better able to cope with poor conditions than maize. Further work on this crop and the introduction of grain sorghums of good keeping quality seems worth while.

2. Very early preparation of land which has been under a resting cover and good early inter-cultivation and weeding have been shown to be factors of great importance in ensuring good yields. Both may be helped by mechanisation, and the use of row-track tractors may do much to break the December/January bottleneck where labour is concerned.

3. Mixed cropping of maize and cotton under true summer crop conditions showed that maize benefited at the expense of cotton in all arrangements. There may, however, be a case for this practice in native gardens, and further experimentation is advisable.

4. The " sifting " work in the breeding block of the past few years seems to be giving some solid results, and the production of cottons which are a real improvement on the existing commercial bulk seems well in sight.

5. Bollworm control remains at the same level as previously and other pests offer no particular threat.

6. Blackarm due to *X. malvacearum* does not appear to be a limiting factor under Nyasaland summer crop conditions, but there is present on certain cottons a disease which resembles blackarm and which requires identification.

PROGRAMME FOR 1948-49.

This will follow much the same lines as that of this past year, but it is hoped that the tractors and implements for the Group Farming Scheme may be available for experimentation on the Station.

[Included by courtesy of the Nigerian Government.]

NIGERIA.

PROGRESS REPORT ON COTTON IN THE NORTHERN PROVINCES FOR THE SEASON 1947-48.

Normal Planting dates Mid-June to end of July.

Normal Picking dates December to February.

FIBRE REPORTS ON 1946 EXPERIMENTS.

Samples were sent to the Shirley Institute from trial No. A.6 (46), the object of which was to discover whether mulching the land in September or October would have any beneficial effect on either yield or quality. Samples were sent from the two mulched treatments and from the control, but differences in measured fibre properties were small and of doubtful significance. A difference might have been expected in the maturity ratio, but the figures only varied between 0.79 and 0.81, the lowest being the control. Similarly there was little difference between the yarns, that from control being intermediate in strength.

Samples of all varieties in the Samaru trial H.2 (46) were sent for analysis, and strain 26.I was outstanding by reason of its relatively low mean and standard fibre weights. 26.F and 26.I were the most mature with a maturity ratio of 0.915 compared with 0.855 for Commercial Allen. Other fibre characters were very similar. 26.C and N'Kourala gave the strongest yarns, with highest standard counts of 53 and 56 compared with 44 for Commercial Allen. It was reported that the yarn for 26.I was outstanding in appearance, being level and free from nep.

In the Daudawa trial there was again little difference except that Commercial Allen gave the lowest fibre weight (the low fibre weight of 26.I in the Samaru trial was not repeated here). Commercial Allen was again slightly less mature than 26.C, and as in the Samaru trial N'Kourala gave the strongest yarn. In appearance that of 26.E was reported as outstanding.

Samples of 26.C from four sowing dates in trial S.1 (46) were sent, and it is interesting that fibre from late sown plots was not less mature. The maturity ratio for the earliest sown was 0.84 and those for the other three dates in order were 0.86, 0.92, 0.87 respectively. The figures for highest standard count for the four dates starting with the earliest were 47, 45, 35 and 40 respectively, so there may have been a tendency for late planting to produce weaker yarns, but that from the fourth sowing was judged very good in appearance and outstanding in this respect.

Of the samples of so-called native types the group from Maiduguri labelled G.1-3 and MG.1-5 were interesting in that as a group they

were much more mature than the Commercial Allen grown in the same plot. Their maturity ratios were 1.00, 0.83, 0.87, 0.88, 0.91, 0.92 and 0.96 compared with that of 0.77 for Allen. The high figures of 1.00 for G.1 and 0.96 for MG.5 were most promising and selection work will be done from these mixed bulks. Unfortunately there was a tendency for these high maturity bulks to have low effective lengths. G.1 was spun and the yarn was best in appearance but weak.

FIELD REPORTS ON 1947 EXPERIMENTS.

Experiment W.3 (47) at Daudawa.

SUMMARY OF YIELDS (LB. LINT P.A.).

	lb. lint p.a.	Ginning %.
26.F	197	35.7
26.I	195	35.6
26.E	194	35.4
26.c (from stage 0 plot 1946)	188	37.0
26.H	181	35.4
26.G	180	34.8
26.c (seed from stage 1 1946)	175	36.6
Oasis... ..	172	33.2
N'Kourala	171	31.7
26.c (selfed seed)	169	34.9
Commercial Allen	156	29.7

S.E. = ± 6.045
 5% sig. diff. = 17
 1% sig. diff. = 23

The following strains were sent by Mr. J. B. Hutchinson and grown in small plots—Koghuzi, Durango Cluster, an Dyura, Tipo Chaco, Esfahan, Cambodia C.02, Parbhani, M.U.8B, bulk of U.4 types, B.181 and 3 selections from Mayo Kebbi. Out of these Koghuzi, Parbhani, Esfahan, M.U.8 and B.181 as early vigorous types were selected for further trial. M.U.8 was especially vigorous and a heavy cropper. Single plant selection work was done on strain "Samaru 26.c" as it was considered that the strain was still segregating for desirable and undesirable characters. Above all, it is intended to select strains which are resistant to blackarm. Messrs. J. B. Hutchinson and E. O. Pearson visited Nigeria and their helpful criticism and suggestions were much appreciated.

Fertilizer trials.

The following is a summary of two trials on cotton carried out by Mr. Greenwood, Agricultural Chemist.

The first trial was to compare superphosphate applied at different rates per acre and at different rates of dilution with soil. The diluted fertilizer was placed in the planting hole before sowing. The treatments were:—no manure; 25 lb. p.a. at dilutions 1 in 260 and 1 in 52; 100 lb. p.a. at dilutions of 1 in 65 and 1 in 13. Stand counts were made on day 6 and day 8 after sowing. The first count showed a significant reduction with the higher dressing and the lower dilution of the lower dressing, but this was only a lag, since by day 8 there was no difference in number of stands. On day 21 (before thinning) oven dry weights (mg.) for whole plants were obtained by sampling 8 stands per plot

and converting the results to mean weight per plot. Figures quoted are for treatment totals, i.e. sums of 4 mean plant weights. All treatments were significantly better than control. On day 71, whole plants were again sampled and on the basis of oven dry weight all treatments were better than control. The interesting point is that, whereas in the early sample the more dilute application of each rate gave higher weights, it was the more concentrated application of each rate which gave higher weights at the second sampling. This was contrary to results obtained by using guineacorn as a test crop.

These results are summarised here :—

Treatment.	Stand count.		Weights (mg.). Day 21.	Sum of 4. Day 71.
	Day 6.	Day 8.		
Nil	188	228	1.025	41.82
25 : 1/260	208	237	1.460	53.65
25 : 1/52	168	224	1.260	63.46
100 : 1/65	164	222	1.662	72.42
100 : 1/13	124	212	1.501	78.62
1% sig. diff.	24.8	—	.328	10.22
5% sig. diff.	18.0	—	.234	7.30

Yields of seed cotton (gm.) and stalk (lb.) in terms of total of 4 plots at harvest time were :—

Treatment.	Seed Cotton.	Stalk.
Nil	3220	19.85
25 : 1/260	3876	24.25
25 : 1/52	4080	25.50
100 : 1/65	4261	31.90
100 : 1/13	4920	37.00
1% sig. diff.	—	11.84
5% sig. diff.	997	8.44

The mean increase over control of the two treatments with 100 lb. superphosphate per acre was 1,370, which was equivalent to 193 lb. seed cotton per acre. At 2.6d. per lb. this was valued at 41/6d., while the cost of the superphosphate was 20/-. Similarly at the lower rate of application the non-significant increase was valued at 24/6d. while cost of fertilizer was only 5/-.

There was also a nitrogen and phosphate placement trial on cotton with combinations of the following factors :—

(N) Nil, 50, 100 lb. Amm. Sulphate p.a.

(P) Nil, 50, 100 lb. Superphosphate p.a.

(Application) C—at base of plant early ; C $\frac{1}{2}$ —at base in two applications ; S—Spread in groove on top of ridge early.

While similar in principle the method of application varied with the different fertilizers. In the early applications the phosphate was mixed with soil and applied before sowing (June 26) in the planting hole,

while the nitrogen was applied after the first thinning (July 19). The late application was in both cases made on Sept. 1st. The first thinning left 4 plants per stand and on July 28 a final thinning to 2 plants was made and the mean weights from phosphate plots were as follows :—

MEAN WT. (GR.) OF THINNINGS. TOTAL OF 6 PLOTS.

100 lb. Superphosphate.		50 lb. Superphosphate.		25 lb. Superphosphate.	Nil.
C	S	S	C	C	
68	66	66	60	52	33

Flowering started on Aug. 7th and a flower count gave a very clear indication that phosphate was the main factor promoting early flowering.

Weights of seed cotton and lint were determined for each plot, and ginning percentage varied only between 35.0 and 35.3, showing that it was not affected by treatment. Differences due to main effects and interaction were not significant, the figures for the main effects in lb. lint per acre being as below :—

<i>Sulphate of Ammonia.</i>	<i>Superphosphate.</i>	<i>Application.</i>
o = 198.1 50N = 207.9 100N = 218.1	o = 181.7 50P = 217.8 100P = 224.6	s = 207.7 c = 201.0 c $\frac{1}{2}$ = 215.3

Stalk weights were also analysed, and here differences due to main effects were significant. The summary in terms of lb. per acre was as below :—

<i>Sulphate of Ammonia.</i>	<i>Superphosphate.</i>	<i>Application.</i>
o = 2488 50 = 2838 100 = 3169	o = 2195 50P = 2948 100P = 3352	s = 2812 c = 2897 c $\frac{1}{2}$ = 2786

1% Sig. diff. = 377.5.
5% Sig. diff. = 277.2.

From these results it would appear that the fertilizer was beneficial in producing a plant potentially capable of carrying a heavier crop. It is possible that high bollworm damage masked the results.

PROGRESS REPORT ON COTTON IN THE WESTERN PROVINCES OF SOUTHERN NIGERIA FOR THE SEASON 1947-48.

Normal Planting dates... .. First 3 weeks of July.
Normal Picking dates January to February.

Work at Ibadan followed the course of selection and multiplication of Ishan A described in previous reports. The growing season was

abnormally wet, the rainfall in the four months July-October totalling 42.9 inches as against a mean figure of 18.6 inches for the same months in the five previous years. The plants in both the selection and multiplication plots were very severely attacked by *Helopeltis* and, in spite of hand-picking, the crop was almost a complete failure. In trials made by the Entomologist there was some evidence of reduced damage in plots sprayed at monthly intervals with 5% wettable DDT, and further trials on this point are to be made.

The failure of cotton at Ibadan in recent years has completely upset the scheme for provision of Ishan A seed for farmers' use, which involves multiplying selected seed for three years at Moor Plantation and then for two years in the Meko district of Abeokuta Province. The visit of Messrs. J. B. Hutchinson and E. O. Pearson provided a good opportunity for reviewing the scheme. In accordance with their suggestions, an effort is to be made to avoid *Helopeltis* damage by growing the selected seed on Moor Plantation in cover of other crops and with protection of insecticides. Alternative sites for the early stages of multiplication are also being sought in more heavily forested areas where observations suggest that damage by this pest is less severe.

WEST INDIES.

COTTON EXPERIMENT STATIONS.

INTRODUCTORY NOTE

BY

J. V. LOCHRIE.

In the introduction to the Progress Reports for 1946-47 a description was given of the agricultural circumstances and of the farming systems and practices under which the crop is grown.

COMMERCIAL CROP.

In the Leeward Islands, the September planting islands—Antigua and Nevis—increased cotton acreage over the preceding season, but unfavourable weather conditions and, in some areas, heavy pest attack kept yields down. The very dry close season caused some delays in land preparation and in the very short season late crops yielded poorly. After some seasons of difficult conditions Montserrat had a favourable year and increased both acreage and yields. In St. Kitts the acreage fell to little over 300 acres owing to labour troubles.

Where alternative crops are available the cotton acreage depends on the prices offered as well as on planting conditions. The present scale of cotton prices and particularly the fact that the price is known by the grower in advance of planting are having effect. Given reasonable planting conditions very considerable increases are expected in all islands.

Conditions for the superfine V.135 crop in St. Vincent were favourable and the yield was well above average. Cotton competes with a range of cash crops and, with high prices offered for groundnuts, crop prospects will be influenced by the growers' view of the relative attractiveness of the various crops. Pink bollworm was not serious but the increase in stainers is perturbing and constitutes a menace to the crop unless serious attention is given to controlling the re-establishment of alternate host plants. Superfine Sea Island cotton is grown also in Barbados and substantial increases in production are expected there.

In addition to the islands with a long record of commercial cotton production, a small acreage has been grown in St. Lucia during the past few years. Interest in the crop has increased and there is room for considerable expansion.

EXPERIMENT STATIONS.

Following good conditions for planting, the season was very dry and short and the crop on the Antigua Station was poor. The effect of unfavourable weather conditions was increased by early and severe infestation by Green stinkbug which caused heavy shedding of young bolls and rotting of older bolls.

Investigations on soil fertility problems were developed and useful evidence is appearing, particularly in connection with land use. The poor results of the common weed fallow in the close season compared with clean fallow were very striking and in addition it is better to use the close season for a catch crop of food crops or green manure than to leave the land in weeds.

The high yield of elephant grass in rotation trials in what was a very dry year is an encouraging indication that the forage needed in any extension of stock keeping can be produced provided it is treated as a crop.

The good effect of pen manure was again evident and the value of comparatively small applications is of particular interest. The results from trials of artificials were less conclusive and more information is needed on rates, and time and method of application of nitrogenous and phosphatic fertilizers.

The pest position in the two seasons of the Station has tended to obscure soil factors in the trials. Pink bollworm, though less severe than in the previous season, was early in the crop and was probably due to carryover in the soil in the dry close season. The Green stinkbug was the main pest and attention to its control is proposed by the use of insecticides and by biological control.

The Camden Park Station of the St. Vincent Government had favourable weather conditions and, with the exception of cotton stainers, pests were light.

The programme covering the maintenance of the quality of the superfine V.135 strain and the seed renewal scheme was continued on the usual lines. Work was also continued with encouraging results on the VH. hybrid material. The best of these strains are in the superfine range as regards quality and continue to yield more highly than V.135. The views of the trade on these strains would be useful and a bulk is being grown for that purpose.

Work on soil fertility and land use is continuing. The rotation trial of cotton following a range of cropping treatments is interesting. As in a comparable trial in Antigua, weed fallow was the poorest and the food crop intermediate between that and the green manure.

COTTON EXPERIMENT STATION, ANTIGUA.

PROGRESS REPORT FOR THE SEASON 1947-48

BY

J. V. LOCHRIE AND J. R. SPENCE.

INTRODUCTION.

The Station was established and is maintained by an allocation from the Comptroller of Development and Welfare in the West Indies. It is from this grant that the salary of Mr. Spence is met.

During the season development work on the Station was completed and the whole area has now been laid out under suitable contour systems. Owing to the effects of erosion in the past the amount of suitable land for field experimentation is somewhat restricted but, when needed, additional sites have been placed at our disposal by the Department of Agriculture. For this and for their interest and assistance in the work of the Station we are indebted to the officers of the Department. We have also to record particularly the assistance given by the Department of Chemistry and Soil Science of the Imperial College of Tropical Agriculture in carrying out analytical work and for advice on soil problems.

The programme of experimentation was carried out but the conditions were very unfavourable owing to drought and to heavy pest attack. Yields on the Station were low, averaging around 500 lb. seed cotton per acre, and were made from a short flowering period. The drought was felt most on "outside" trials where delays in land preparation and planting still further shortened the season.

The main work—described in earlier reports—is concerned with problems of soil fertility and management. For reasons which will be discussed later some of the fertilizer trials were disappointing but interesting results were obtained from preliminary trials on the handling of the land during the cotton close season. Observation, particularly in peasant crops, showed poor early growth following delayed preparation of the land, and experiments along these lines have shown a very high increase in growth and yield where land is kept free of weeds during the close season. It is admitted that land kept free from weeds will be more prone to erosion but, with limited land resources, high productivity is essential. Soil conservation measures are of the utmost importance and it is against a background of sound erosion control that these experiments are planned. Systems of crop rotation are under investigation, but this is long term work; the productivity of the various crops in a rotation is, however, of economic importance and this is being studied together with the effects of the various crops on soil factors.

Insect pest attack was again an important factor. Despite the long close season and the careful attention given to clean up of fields and cotton stores, there was an early appearance of Pink bollworm on the Station and elsewhere. Of more importance on the Station was an infestation by *Nezara viridula* which caused a heavy loss of the valuable early-formed crop. The significance of this pest was noted last season, and, later in this report, its status and the measures proposed for its control are discussed.

General information on the season is given in Table I.

TABLE I.

				Island Crop.	Station.
Legal close season	...	...	...	15th May to 22nd August.	
Planting period	...	...	...	22nd August to 31st October	25th August to 1st September.
Harvesting	...	...	...	January to May	January and February.

METEOROLOGY.

The rainfall is given in Table II., A for the 1947-48 season, and B the average for the past 30 years.

TABLE II.

				June, inches.	July, inches.	Aug., inches.	Sept., inches.	Oct., inches.	Nov., inches.	Dec., inches.	Jan., inches.	Feb., inches.	Mar., inches.	Apr., inches.	May, inches.	Total, inches.
A	...	...	...	2.13	2.59	2.25	8.24	2.06	0.71	0.44	3.21	1.13	2.32	0.42	2.74	28.24
B	...	...	...	3.82	3.74	4.43	4.77	5.22	5.35	2.86	2.38	1.62	1.54	2.04	3.27	41.04

The total rainfall for the year amounted to 28.24 inches which is only $\frac{2}{3}$ rds of the average for the area and little above the lowest recorded during the 30 year period. Following a dry close season, rains fell in late August, coinciding, with commendable aptness, with the legal start of the planting season. Excellent falls continued through September and the Station crop was all planted within a few days and established well. Two heavy falls occurred during this period but the contour measures proved satisfactory and there is no doubt that the resultant conservation of water enabled the plants to hold on and produce a fair crop in spite of the later drought. Conditions were satisfactory through October, but the soil dried out very much in the drought which continued to early January. By then flowering had fallen off and shedding was marked. In spite of the poor moisture conditions and the early close of flowering a reasonably good crop would have been matured but for the attack by *Nezara viridula* which by early December had built up to serious proportions.

AGRICULTURE.

Manuring.—Small amounts of Pen Manure are applied when available, but in general the crop is not manured and no information is available on the fertilizer needs of cotton on these soils. Trials were

started last season to include investigation of amounts and kinds of fertilizers and of the best time and method of application.

The N.P.K. trials of $3 \times 3 \times 3$ design were continued on the Station and on a number of soil types elsewhere. Two of these district trials got away poorly owing to planting delays, and served only to stress the need for early and good preparation of the land and for simpler designs where the sites of trials are not under direct control. Those on the Station and on Government land were planted early and established well. Moisture was the limiting factor and this, coupled with severe pest infestation, reduced yields and also the value of the trials. Growth records were taken and afforded data of interest.

It was suggested that the effect of phosphate on the Rendzina soil of the Station might be missed where applications were small. To meet this the levels of P. were raised to 500 and 1,000 lb. superphosphate per acre and the sulphate of ammonia correspondingly raised to 250 and 500 lb. The rates of sulphate of potash were 150 and 300 lb. and all fertilizers were broadcast along the sides of the ridges 2 weeks after planting. As far as K. and P. are concerned the results, both on growth and yield, were similar to those of last season. Potash again showed no effect and this agrees with the potash status of this soil as shown by soil analyses, while phosphate gave increases both in early growth and yield. The double application yielded less than the single rate. All trials so far have indicated the value of phosphate on this soil and a wide range of rates of application, starting from a low level, will be tested in the coming season. The effect of N., as sulphate of ammonia, this season was to give a significant depression both in early growth and in plant stands, compared with growth increases last season. This striking effect is attributed to the high concentration of the fertilizer near the seedlings as the week following the application was without effective rain. The effect of sulphate of ammonia on stands was reduced in the presence of superphosphate and this reduction was in proportion to the amount of superphosphate applied.

Pot tests were carried out to test the effect of high concentrations of sulphate of ammonia on cotton seedlings. Two rates of application were used and two rates of watering, the lower approximating to the conditions in the field trial. In addition surface applications at different distances from the seedling were compared with placement at two different depths. The results showed (1) that surface applications gave better germination and growth than when the fertilizer was placed under the seed (2) that surface applications in a ring 4 inches to 5 inches from the seedlings were better than in a smaller ring, more particularly with a high rate of fertilizer and a low watering rate (3) that the small ring application was fairly satisfactory at the lower level of fertilizer especially where the watering rate was high. With low watering there was growth depression which was greatest with the high rate of fertilizer. These latter conditions approximated to those experienced by the crop in the field trial already described, and indicate the cause of the slow growth and loss of stand from the sulphate of ammonia.

It is apparent that early top-dressing on ridges can be dangerous with cotton and it would be safer to apply sulphate of ammonia at a later stage, possibly just before the start of flowering. Further information is needed on amounts, time of application and the possibilities of fractional applications, and additional trials on these lines are proposed.

A similar N.P.K. trial was carried out on a very heavy soil type under otherwise similar conditions to that already described. Yields were much higher—1,200 lb. seed cotton per acre—but affected by a lesser but patchy pest attack. Again K. gave no effect but P. showed growth increase.

During the close season maize was planted to assess residual fertilizer effects in these trials. Conditions were dry but the results were similar in each case. The effects of K. and N. were negligible but P. gave considerable increases, the effect on growth being particularly marked on the heavy soil.

The time of application of sulphate of ammonia was investigated using a standard rate of 300 lb. per acre applied (a) all at planting (b) one half each at planting and thinning (c) one third each at planting, thinning and at start of flowering, and (d) no manure. Treatment (c) yielded significantly higher than all others with (a) lowest. The failure of the complete application at planting is probably due to a high rate under dry conditions as described earlier, but the success of the application in 3 fractions needs further clarification. It may indicate merely the value of nitrogen applied at an advanced stage of the crop when the nitrate built up in the soil during the close season is exhausted. This type of trial is being redesigned.

A trial of two kinds of superphosphate was badly affected by losses through *Nezara* infestation, and yields were low. The indications for this season of low rainfall were: (a) the superiority of superphosphate placed in the ridge under the seed over the broadcast method in plant growth, flowering and yield, (b) higher growth rate from powdered superphosphate compared with a granulated form.

Pen Manure.—The trial described last season was continued on the same site with pen manure—equivalent on analysis to 28 lb. N., 12 lb. P_2O_5 , 40 lb. K_2O . per ton—applied at 3, 6, and 9 tons per acre. A treatment of artificials equivalent to 6 tons pen manure was included in the trial. The site was bare fallowed during the close season and the pen manure was incorporated in the ridge 2 weeks before planting. The artificials were applied as a top dressing 10 days after planting. Germination and early growth were good and treatment differences were early apparent. Growth samples measured by green weight were taken (a) at 24 days and (b) at 57 days from planting. The results, following with remarkable similarity those of the previous season, are summarized in Table III as percentages of the unfertilized treatment.

TABLE III.

<i>Treatment.</i>	<i>Growth (a)</i>	<i>Growth (b)</i>	<i>Flowering.</i>	<i>Yield.</i>
3 tons pen manure	121.7	124.3	112.8	130.7
6 " " "	126.9	128.9	117.6	136.0
9 " " "	126.9	137.2	124.1	142.6
Artificial = 6 tons	112.9	117.1	107.4	122.4
Nil	100.0	100.0	100.0	100.0
S.D. P = .05	10.6	14.1	—	23.7

The pen manure at all levels gave highly significant increases in growth and yield and again the higher rates of application gave only slight additional increases. Artificial alone were again intermediate in growth and yield. It would appear that applications of pen manure much above the 3 and 4 tons used as the lowest rate in the two seasons' trials are not economic under these conditions, and in view of the general shortage of pen manure this good effect of low rates is encouraging. Also fertilizer trials on this soil indicate the need of phosphate, and the addition of superphosphate to the manure should increase the effect of small applications. The trial will be continued but the method of applying artificials will be changed. The phosphate and potash will be applied before planting, as is done with the pen manure, and the nitrogen as a top dressing in two applications.

Fertilizer trials with maize gave high yields of up to 2,800 lb. grain per acre, and as with cotton the only increase came from phosphate applications.

Spacing.—A spacing trial was planted on the standard 40 inch ridges with row spacings from 12 inches to 36 inches. As with the rest of the Station, crop yields were low, but the results are of value in confirming those of the previous season with better rainfall conditions and much higher yields. The best plant density appears to be around 10,000 to 12,000 plants per acre—when reduced much below this there is a falling off in yield. There seems little difference whether the density is made up of 1 plant per hole or 2 plants at twice the interval but with a wider interval and 3 plants per hole there is again a falling off in yield.

As a result of last season's trials with maize a standard spacing of 1 foot, giving a plant density of about 12,000 plants per acre, was adopted. The present trials, under drier conditions, have confirmed this superiority. Under the conditions widening the spacing did not lead to great reductions but, as might be expected, the very close spacings yielded poorly.

ROTATION.

The trials described in the previous report were continued. The present system of agriculture is almost entirely the monoculture of a crop—cotton or cane—for export. Planned crop rotation scarcely exists; pen manure is little used; and the growing of forage for stock is quite foreign to cultivators.

Rotation A.—This is a simple form of trial set out to see the effects on subsequent crops of cotton, and on soil fertility of:

(1) 3 crops of cane—plant cane and two ratoons; (2) elephant grass for the same period; (3) a periodic break in cotton growing by a complete year in green manure; (4) continuous cotton as is common in practice. The treatments are subdivided into an unfertilized series and one receiving applications of phosphate and nitrogen. The sugar cane and elephant grass were planted in May, 1947, and cotton in late August. All phosphate was applied at planting and the crops top-dressed with 200 lb. sulphate of ammonia, and further top-dressings were given to the grass plots after each cutting.

Rotation effects will of course not become available for some years but crop productivity is being measured and the influence of the crops on the soil is being followed up by examination of changes in soil structure and of the fluctuation in soil moisture and nitrate. In spite of the very low rainfall since the trial started the yield of forage is encouraging and the figures for the first period of nine months are given in Table IV.

The application of fertilizer gave over 20% increase for the period and subsequent observation indicates that the gain will become progressively greater as the trial continues.

TABLE IV.

Date of cutting.	Lb. green matter per acre.		% increase.
	Unmanured.	Manured.	
10/9/47	29,983	35,792	19.4
24/10/47	29,312	34,757	18.6
22/12/47	13,688	15,972	16.7
2/2/48	10,995	12,944	17.8
Total 9 months	82,310	99,492	20.7

The cane crop was cut in April and yielded 18 tons of cane per acre in spite of the very late planting and low rainfall. Differences due to fertilizers were slight.

Rotation B.—Much of the cotton crop is grown year after year on the same land, and the present trial investigates various means of utilising the period between cotton crops. The treatments are maize, green manuring, weed fallow as is the common practice, and bare fallow.

The close season was drier than usual; only 10 inches of rain fell during the 4 month period, much of this in very small showers. Growth on the various treatments was well below normal, with the maize yielding around 900 lb. grain per acre.

The maize was reaped and the green manure and weed fallow dug in just prior to planting cotton. Treatment differences were very striking and data on plant growth and yields are given in the following table.

TABLE V.

Close Season Treatment.	Growth as green weights as % of weed fallow.		Yield in lb. seed cotton per acre.
	27 days.	57 days.	
Maize	123	154	568
Green Manure	124	191	721
Weed Fallow	100	100	487
Bare Fallow	180	255	912
S.D. P = .05	17.5	22.1	163

The results strikingly confirm the opinion, gained from field observations in the cotton areas, that the general yield level could be raised very considerably by efficient and early preparation of the land. It has to be noted that in practice the late cultivation of a weed fallow is often followed by planting delays and further loss of crop from pink bollworm infestation built up in early plantings. An objection to the practice of bare fallowing might be made in that it renders the land more subject to erosion. Cotton gives the soil little protection particularly in the early stages and almost all the land growing cotton needs suitable soil conservation measures as a prime essential. It is only in combination with adequate protection from erosion loss that intensification of production can be achieved.

Soil moisture determinations were made periodically during the course of the trial but, owing to delay in obtaining equipment, the study of the fluctuation of soil nitrate was delayed. Soil moisture was highest in the bare fallow plots before the planting rains came, but moisture conditions were excellent after planting and the differences in plant weight at 27 days may be due to nitrate accumulation rather than to moisture differences. Accumulated moisture in the bare fallow plots may however have contributed to the better finishing of the plants in the dry conditions. The trial is being repeated with a follow up of soil moisture and nitrate.

Soil Rehabilitation.—It was recorded in the previous report that considerable amounts of hilly soil occur on the calcareous clay areas. They are similar to the valley soils but shallower, and the marl deposit is often of little depth. Pressure on the land is forcing this area into cultivation but productivity is low, and erosion soon becomes apparent. Investigations have been started to ascertain whether this land can be brought into production under suitable soil and water conservation measures and land use systems. The rotation treatments range from more or less permanent grass for cutting as forage through temporary grass leys to continuous cultivation. A range of different soil conservation methods is included and the effect of manures is being examined.

The present dry season was a severe test of these thin soils but all the rain was held on the land under the close contouring and bench terracing systems and this conservation of water should do much to effect improvement. Yields of maize and cotton were about half those of the adjoining valley soils but this is of less importance than the long term consideration as to whether productivity can be maintained and built up. Guinea grass (*Panicum maximum*) appears well suited to

these calcareous soils and its cultivation could add considerably to the production of forage with a consequent increase in animal products. It is probable that the best system for these hilly soils may be based on the use of this grass for some part of the rotation.

Type Collection.—The collection of Sea Island strains was maintained and it is proposed to bulk up some of these, together with promising VH strains from St. Vincent, for further trials in the Leeward Islands.

It was noted last season that the environmental factors responsible for the difference in quality of the same M.S.I. strain grown in different Islands are still not clear. A recent range of samples from various soil types in Montserrat and from areas of wide differences in soil fertility showed no differences in fibre quality but only in actual yield. It is significant that the Islands producing cotton coarser in fibre and of lower yarn strength plant the crop in August-September while the finer fibre and stronger yarn comes from the Montserrat and St. Kitts crops planted in March-April. A series of dates of planting would clear up this point but the danger of carryover of pink bollworm precludes this being done in the open. A start has been made to collect samples from caged plots of different planting dates and this will be continued over some seasons.

INSECT PESTS.

Pink Bollworm.—Owing to the quick close down of the previous crop the close season was in practice longer than the legal 3 months and it was expected that this would result in reducing the carryover of the pest. Special attention had been given to control measures by careful clearing of field debris and the cleaning and disinfection of sheds, but despite this some infestation was seen early in the crop. It would appear that the carryover this season must be attributed to the survival of resting larvae in the soil due to the dry close season. The infestation increased in December and January and with a longer season there would have been little prospect of a late crop.

Leafworm.—This was general in the cotton areas and most crops required regular spraying. The pest is fairly easy to deal with but its control adds a considerable item to the cost of cotton production.

Stainer (*Dysdercus* sp.).—Only a few broods of stainer were found on the Station and, as in the previous year, little in commercial cotton.

Nezara viridula.—This pest has hitherto received little attention as a pest of cotton though its attacks on tomatoes and beans are acknowledged. During the two seasons of the Station's operation *Nezara* has been an important pest and more particularly as the damage affected the valuable early crop. The pest was in the crop in numbers before flowering started and caused extensive shedding of young bolls, and staining and poor opening of older bolls. Material examined by the Mycological Department of the Imperial College of Tropical Agriculture showed the organism to be *Nematospora gossypii*.

Population counts showed a rise to just over 3,000 *Nezara* per acre in the Station cotton in late November with a peak of 4,000 in late December. The numbers fell off rapidly with the loss of leaf and end of flowering in January. Similar collections were made on a field of Lima beans up wind from the cotton and large populations of over 10,000 per acre were recorded by early December increasing to a peak infestation of over 20,000 a month later. Nymphs were recorded separately and accounted for around 40% of the total population in the beans during December, then falling off rapidly with the cessation of fruiting. On the cotton the proportion of nymphs averaged around 12%. Cotton up wind from the bean crop carried a much smaller infestation never reaching 1,000 per acre. It would appear that the bean crop built up the infestation which spread to cotton aided by the wind. The large differences in pest populations in the two crops and the relative proportion of nymphs indicate that the beans were a more suitable host and may offer possibilities for control by trap-cropping.

Examination of green bolls clearly showed the severity of the damage due to *Nezara* as the position was not obscured by the presence of *Dysdercus*. Over the collection area, which finally yielded 500 lb. seed cotton per acre, the proportion of bolls attacked was as high as 80% by early December. On a highly infested section 1,000 flowers were tagged each week and sheds collected and examined. During the period about 70% were shed at various stages. Where examination was possible it showed evidence of puncturing in over 90% of cases. Of the remaining 30% which was not shed only a small proportion produced clean cotton and there is no doubt that *Nezara* was responsible for the bulk of the loss.

Though these two seasons may have been abnormal as regards infestation by *Nezara* it is obvious that the pest can be a serious cause of crop loss.

Parasites of the pest are recorded in other countries but during the past two seasons consignments of *Nezara*, examined by Dr. Simmonds of the Imperial Bureau of Biological Control, have shown no instances of parasitism by *Trichopoda spp.* in Antigua, but a collection made in Montserrat showed a small degree of parasitism by *Trichopoda pillipes*. Dr. Simmonds has suggested that the introduction of *Trichopoda pennipes*, which is said to be efficient in Florida, might be of value. The co-operation of the U.S. Department of Agriculture has been obtained and it is hoped to carry out the project, with the assistance of Dr. Simmonds in the coming season.

In addition to biological control it is proposed to carry out trials of insecticides on the Station if there is a recurrence of the infestation.

PROGRAMME FOR 1948-49

The programme of fertilizer investigation on the various soil types will be continued both on direct and residual effects. As a result of experience this season additional trials will be carried out with wide ranges of rates of application of nitrogen and phosphate.

Time and method of fertilizer application will be given further examination.

Rotation and land use experiments will be carried on as described. In agricultural policy the extension of stock keeping is stressed, but development must depend on added provision of forage from established productive grasses. The present rotation experiments will give information on the productivity of the grass crop, its effect on the soil, and on following arable crops. It has already been shown that the growth and yield of cotton were greatly reduced after a short term weed fallow and this indicates the need for information on the handling of grassland in preparation for cropping. A trial is being started—on old grassland—to investigate various lengths of bare fallow period and of fertilizer treatments. Studies on the changes of soil structure and on the fluctuations in soil moisture and nitrate will complement those from the rotation trials.

The collection of typical Sea Island strains and of variable bulks will be maintained.

[Included by courtesy of the Government of the Windward Islands.]

CAMDEN PARK EXPERIMENT STATION, ST. VINCENT.

PROGRESS REPORT

ON THE

COTTON BREEDING WORK FOR THE SEASON 1947-48.

BY

W. R. E. NANTON.

GENERAL INFORMATION.

	<i>Island Crop.</i>	<i>Experiments.</i>
Sowing dates	15th August to 30th September ...	5th to 17th September.
Picking dates	December to February	—
Legal close season	15th May to 14th August	—

WEATHER CONDITIONS AND PESTS.

Conditions generally were favourable for planting, and with the exception of certain of the progeny rows which suffered badly from waterlogging, good stands were obtained in the experiments, and cotton plots as a whole. Throughout the season, the weather could be said to be highly favourable to plant growth, and with the exception of the small bulks trial, planted on rather poorer land, extremely good growth was made and the crop reaped in most sections of the cultivated area was excellent. There were attacks by *Alabama argillacea* leafworm, but these were quickly controlled by spraying with colloidal lead arsenate. Cotton stainers proved troublesome during the fruiting season, and gave rise to some staining of the lint ; Pink bollworm appeared late, and did but little damage.

BREEDING PROGRAMME.

The breeding work carried out may conveniently be discussed under the following heads :

- (a) The V-135 seed renewal scheme.
- (b) Work with VH hybrid material.

V-135 seed renewal scheme.—Following the established practice, sixteen progenies were grown in the 1947-48 season from sixteen plants selected from the previous season's progeny rows. Samples of all progenies grown in the 1946-47 season had been sent to the Shirley Institute for small scale spinning tests, and pending the receipt of the

results, representative plants of each of these were carried on in reserve progeny rows during the season under report.

On receipt of the spinning test report only the best of the reserve progeny rows were reaped and recorded and these were renumbered in consecutive order. Two of the 1946-47 progenies selected for perpetuation gave rather poor spinning values in tests. Their progenies were therefore dropped entirely and the number made up by the selection of superior types from the reserve progeny rows.

The usual yield and seed cotton characters were measured, and selection of parents for the 1948-49 work was made on these. Full emphasis was also given to the results of spinning tests. A list of the selected progenies and plants is given in Table I.

TABLE I.
SELECTIONS FROM V-135 PROGENY ROWS 1947-48.

Selected Progeny.	1946 Parent.		Strain.	Selected Plants.
	Progeny.	Plant.		
V.4726 	V.4626	5	V(30)46	Nos. 16 & 18
V.4742* 	V.4627	10	"	" 4 & 16
V.4730 	V.4629	10	"	" 1 & 17
V.4746* 	V.4630	12	"	" 2 & 16
V.4748* 	V.4635	3	V(37)11	" 2 & 13
V.4737 	V.4636	19	"	" 6 & 12
V.4752* 	V.4637	12	"	" 2 & 20
V.4738 	V.4638	8	"	" 7 & 14

* From reserve progeny rows.

No off-type plant was observed in the V-135 breeding material of 1946-47, and no progeny was so markedly inferior as to warrant its rejection. All self seed not required for progeny row work was therefore sown to provide the first stage of multiplication of the island's supply of planting seed.

The second stage of multiplication was carried out partly at Diamond Estate and partly at Camden Park. Weather conditions at both sites were favourable, and a good crop of good quality seed was obtained.

Work with VH Hybrid material.—In the main breeding trial, twenty-four VH.8 progenies were compared with a representative V-135 progeny. In the analysis of the 1946-47 V-135 progeny rows, it was observed that V.4625, the progeny used for comparison in that year, was markedly inferior both as regards yield characters and spinning value. In the 1947-48 work therefore, a more representative progeny, selected from V.4635, was used as the control in the trials.

The main trial was laid out as a 3(5 × 5) lattice square design, each plot comprising 8 plants, 4 each on two 4' ridges.

During the season being reviewed, the results of spinning tests carried out on the 1946-47 material became available, and gave strong support to the preceding year's results. Selections based on the latter proved to have been good ones when viewed in the light of the former results. No important progeny failed to obtain representation in the new trial, and discarded material likewise proved to be of poor spinning

value, indicating that large differences in yarn strength were due to inherent differences between the progenies tested, and not merely of environmental origin.

Of greater importance was the fact that two of the progenies, viz. VH.4602 and VH.4621, were superior to the V-135 progeny included in the trial for comparison. As this progeny was definitely inferior in spinning quality, the mean for all V-135 progenies grown in progeny rows in the same year was computed for comparison. It is also of interest to note that these two progenies, although grown under somewhat different conditions, gave stronger yarns than a sample of V-135 lint from the first multiplication plot of the same year. The results may be summarised as follows:

COUNT X STRENGTH PRODUCTS CORRECTED FOR COUNT DIFFERENCE.

VH.4602	2805
VH.4621	2829
Mean for all V-135 progenies, same year	2882
Strongest V-135 progeny, same year	2983
Weakest V-135 progeny, same year, excluding that used in trial	2788
V-135 progeny used in trial	2717
Sample of V-135 from 1st Multiplication Plot same year	2774

From the above it will be seen that although the best VH progenies cannot be considered as being as good as average V-135 strains, these progenies are nevertheless well within the range acceptable in the superfine class, while their superiority in yield characters over V-135 is well established.

In making selections from the current year's material, attempts were made to reduce further the yarn strength range by selecting from only the best spinning families, while taking care to consolidate the gains already made in yield characters. In Table II, the relevant data are summarised. Thus, selected progenies were taken from families VH.4601, VH.4602, and VH.4621 only. Family VH.4601, though its spinning behaviour could be considered as only fair, could not be ignored, because of the consistently high yields shown by its progenies. VH.4602 was outstanding in both yield and spinning behaviour while VH.4621 gave the strongest yarn. From these families, eight progenies were selected, and from each of these, three plants for 1948-49 trial.

TABLE II.
SUMMARY OF DATA—MAIN BREEDING TRIAL 1947-48.

Strain.	Family.	Yield of Lint.	Ginning Out-turn.	Bolling index	Yarn strength.*
VH.4502	VH.4601†	gm. 741	% 28·6	arb'ry. 1031	2638
	VH.4602†	836	28·4	1054	2805
Mean		788·5	28·5	1042·5	2721
VH.4508	VH.4617	683	27·1	965	2571
VH.4509	VH.4620	578	25·5	774	2556
	VH.4621	690	25·8	980	2829
Mean		634	25·65	877	2692
VH.4510	VH.4623	647	25·9	973	2660
All VH Progenies		696	26·82	966	2674
V-135		603	24·75	898	2904

* Parental values only.

† Families selected.

In the small bulk trial, the families contributing to the current year's breeding material were retested in a small plot latin square experiment. Here, as in the main breeding trial, the V-135 strain previously used as a standard was abandoned in favour of a sample representative of the first multiplication stock. The trial was planted on a rather worn-out hillside in order to compare the VH material with V-135 under low fertility conditions. No manure was applied to any plot.

Weather conditions proved to be ideal, and, in spite of the poor experimental site, a very fair crop was reaped. The general level of yields for the trial as a whole worked out to be 248 lb. of lint or more than half a bale per acre.

The statistical results of the trial were poor. The standard error was very high, with a coefficient of variation of 27%. Differences between families, though considerable, could not be judged to be of significance, nor could the mean for all VH progenies be shown to be significantly different from that for V-135, although there was a disparity of 14.5% in favour of the hybrids.

The trial was, however, of value, because it substantially confirmed the results of the previous year's main breeding trial, the order of merit of the families not being appreciably disturbed.

VALUATION OF VH COTTON.

One and a quarter acres of the best VH material available was planted to procure a bale of lint for broker's valuation. The area was planted rather late in the season, and the crop did not do well. In view of this, and to guard against any undue prejudice which may have been set up on account of the unfavourable growing conditions, this lint was not forwarded for valuation as intended. A further area is being grown in the 1948-49 season.

HIGH LEVEL NITROGEN-PHOSPHATE MANURIAL TRIAL.

A small plot 3×3 factorial experiment was laid out with VH cotton on alluvial soil at the Station to test the effects and interactions of three levels each of sulphate of ammonia and superphosphate. The treatments applied were as follows:—

n ₀ —Sulphate of Ammonia :	None.
n ₁ —	" " " 400 lb. per acre.
n ₂ —	" " " 800 " " "
p ₀ —Superphosphate :	None.
p ₁ —	" 400 lb. per acre.
p ₂ —	" 800 " " "

All combinations of pairs of these treatments were applied. Three complete replications were provided to give 27 plots in all.

Analysis showed that no manurial treatment differed significantly from another, both main effects and interactions between manures proving to be non-significant. The data are nevertheless of interest and are therefore summarised in Table III.

The error of this trial too was high, suggesting that the degree of replication was inadequate in this instance. In commercial practice, however, some of the differences are sufficiently large to warrant closer examination if for no other purpose than to draw clues as to the lines along which further investigations should be made.

TABLE III.
HIGH LEVEL COTTON MANURIAL TRIAL.
MAIN EFFECTS AND INTERACTIONS—LB. LINT PER ACRE.

	P ₀	P ₁	P ₂	Total.	Mean N-effect.
n ₀	239	282	251	772	275
n ₁	297	227	247	771	257
n ₂	273	268	198	739	246
Total	809	777	696	2282	—
Mean P-effect... ..	267	259	232	—	253

Viewed in this light, the single nitrogen response in the absence of phosphate seems of importance and confirms the results of many experiments conducted in the past. It seems likely, too, that, at 800 lb. per acre, the optimum rate for sulphate of ammonia may have been exceeded considerably. The effect of the single dressing of phosphate, without nitrogen, is not in accord with previous experiments, and is possibly only a local effect. There appear to be indications of a strong negative interaction between nitrogen and phosphate, especially at the higher levels. These interactions accounted for nearly 65% of the total treatment sum of squares. The main effects of nitrogen may therefore have entirely been eclipsed by the presence of massive doses of superphosphate.

From the results of this trial there seems to be no reason for varying the general recommendation of a dressing of 3-4 cwt. of sulphate of ammonia for the soil type in question.

ROTATION TRIAL.

A trial aimed mainly at investigating the most profitable use of land during the cotton close season was started during the year 1947. Five rotations, all equivalent as regards the crops to be grown, but differing in the order in which they appear in the rotation scheme, are under trial. The arrangement is such that main crops may be regarded as "indicator" crops, while catch crops, green manure crops, and fallows might be designated "soil treatment" or briefly, "treatment" crops. Thus "treatment" crops are sown during the cotton close season, and their effects measured by the differential response in the succeeding cotton crop. Other "indicator" crops occurring in the rotations are maize, sweet potatoes and black-eye peas. In this way comparisons can be made between these last named crops and cotton as to their relative financial values, and similarly information will be available to aid in the selection of catch crops during the cotton close season.

The experiment is of the split-plot randomised block design. Rotations appear in sub-plots and indicator crops in whole plots to give a compact unit for comparing effects of "treatments".

The treatments applied during the close season were the following : weed fallow, green manure, pulse, catch crop of sweet potatoes, catch crop of maize. Unfortunately, the pulse crop (soya beans) was planted too late and had to be turned in when the cotton planting season arrived. In effect therefore it was actually a green manure, as no crop was taken.

An analysis of the yields of cotton following these treatments showed them to be significant. The results are summarised hereunder :—

<i>Cotton following</i>					<i>Yield Seed Cotton p.a.</i>
Green manure	...	...	...	...	1,378 lb.
"Pulse" (really green manure)	...	...	...	...	1,310 "
Maize	...	...	...	...	1,227 "
Sweet Potatoes	...	...	...	...	1,166 "
Weed Fallow	...	...	...	...	1,051 "
Significant difference	...	...	...	...	220 "

Thus the yield of cotton following a green manure was significantly superior to that following a weed fallow, and the taking off of catch crops of corn and sweet potatoes produced no adverse effect.

The yield of maize was apparently not affected by land use immediately prior to planting. Differences in yield were small and statistically insignificant.

PROGRAMME OF COTTON EXPERIMENTS FOR 1948-49.

- Breeding.*
- (1) V-135 progeny row non-replicated trial.
 - (2) VH8 breeding trial.
 - (3) VH8 progeny rows.
 - (4) VH8 small bulk trial.
 - (5) Production of VH bale for valuation.
- Field Experiments.*
- (6) Pilot manurial trial—sulphate of ammonia vs. cotton seed and coconut meals.
 - (7) Continuation of rotation trial.

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- "The Extension of Cotton Cultivation in Tanganyika Territory." Major Hastings Horne. 1922. Price 2s.
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- * "Reports from Turkestan Plant Breeding Station, Tashkent." 1928.
- "Review of the Situation in the Principal Cotton-Growing Territories of the Empire, and a Summary of the Main Activities of the Corporation since their Formation." 1928. Price 9d.
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- * "The Principles and Practice of Field Experimentation." J. Wishart and H. G. Sanders. 1935.

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